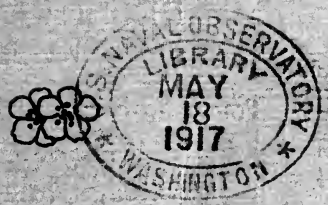
Casella, C. F. C 3426

SURVEYING AND DRAWING INSTRUMENTS



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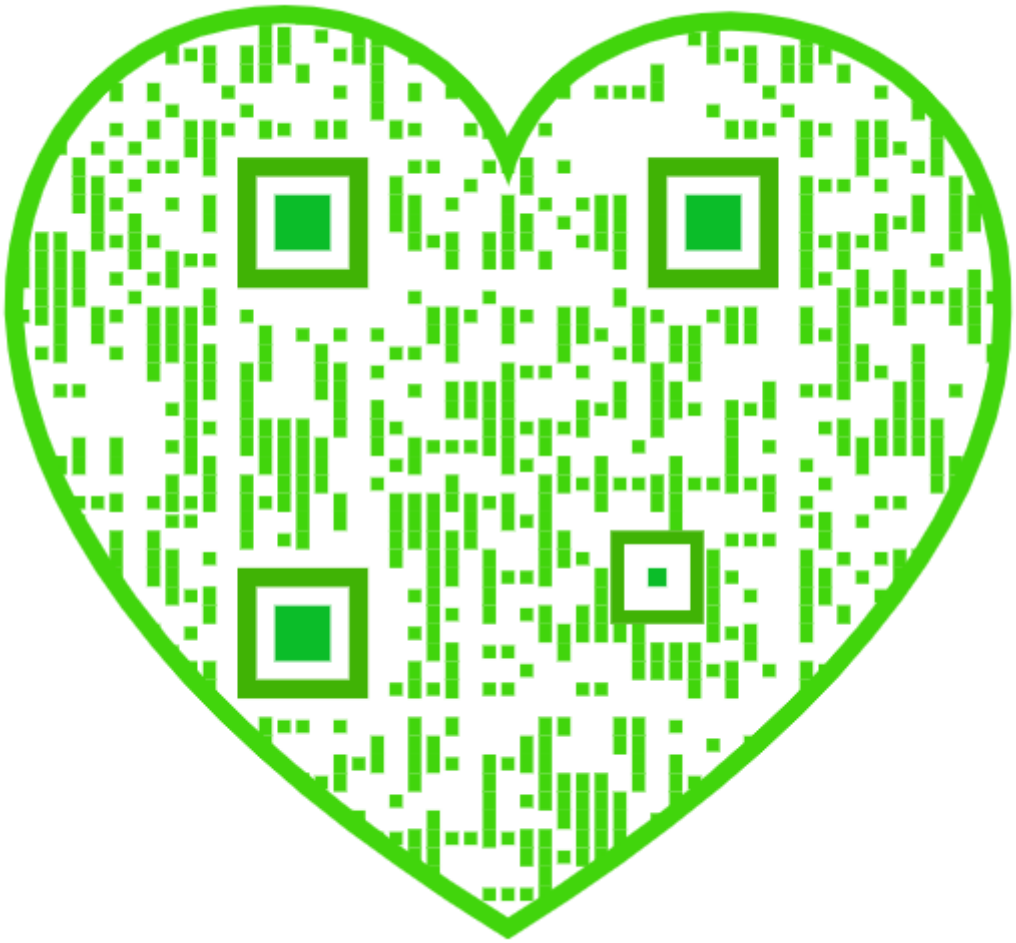

RECENT AWARDS

Franco-British Exhibition, London, 1908—
GRAND PRIZE AND
DIPLOMA OF HONOUR.

Japan-British Exhibition, London, 1910—
DIPLOMA.

Engineering Exhibition, Allahabad, 1910—
GOLD MEDAL.

51599

SURVEYING AND DRAWING INSTRUMENTS

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C. F. CASELLA & Co., Ltd.

MAKERS OF

SURVEYING, METEOROLOGICAL & OTHER SCIENTIFIC INSTRUMENTS

TO

The Admiralty, Ordnance, Office of Works and other Home Departments, and to the Indian, Canadian and all Foreign Governments.

---

11 to 15, Rochester Row, Victoria Street, London, S.W.

1911

Established 1810.

List No. 330.

This List cancels previous issues and is subject to alteration without notice.

The prices are for delivery in London, packing extra.

New customers are requested to send remittance with order or to furnish the usual references.

Y-THEODOLITES

(1) **3**-inch **Y-Theodolite**, divided on silver, with verniers reading to 1 minute; with rack adjustment, achromatic telescope, erect and inverting eye-pieces, tangent screw and clamp adjustments, compass, cross levels, three screws and locking plate or parallel plates, etc., etc., in mahogany case, with tripod stand, complete... ... **£19 10 0**

Weight of instrument, case and stand, about 14 lbs. (6·4 kilos).

(2) **4**-inch Do., with all improvements, as above, to 1 minute... **£22 0 0**

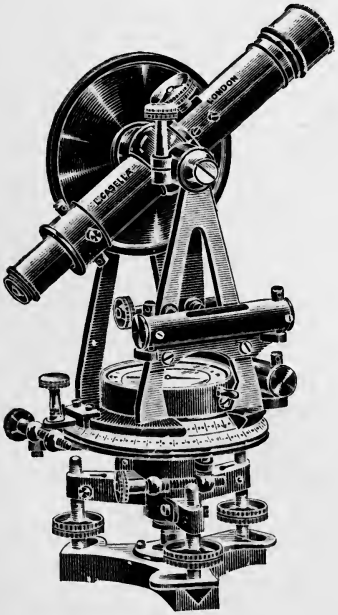
(3) **5**-inch Do., ,, ,, ,, ,, ... **£24 0 0**

(4) **6**-inch Do., ,, ,, ,, 20 seconds **£27 0 0**

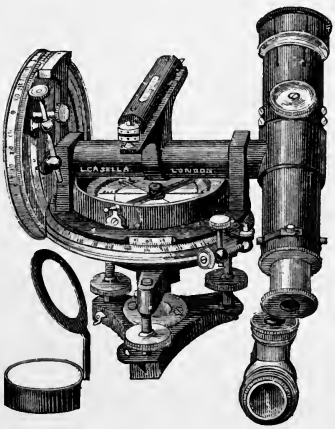
(6 inch, to 10 seconds, 40s. extra.)

Larger sizes and special patterns made to order.

TRANSIT THEODOLITES.



No. 5.



No. 6.

TRANSIT THEODOLITES—Continued.

(5) **3**-inch **Traveller's Transit Theodolite**, with *telescope in centre*, in a small and compact form, light and handy for Alpine and military surveying and occasional astronomical observations; with diagonal, inverting and erect eye-pieces, and reflector, in case $10\frac{1}{2} \times 5 \times 4$ inches, with tripod stand **£19 10 0**

Weight of instrument, case and stand, 9 lbs. (4 kilos.)

(6) **3**-inch **Traveller's Transit Theodolite**, as above, but with *telescope at side*; in case $7\frac{1}{4} \times 5\frac{1}{2} \times 4\frac{1}{2}$ inches, complete with tripod stand **£16 10 0**

Weight of instrument, case and stand, $8\frac{1}{4}$ lbs. ($3\frac{3}{4}$ kilos).

This is not quite so convenient an instrument as No. 5, owing to the position of the telescope, but it is lighter and more compact, and is often used for mining and similar work.

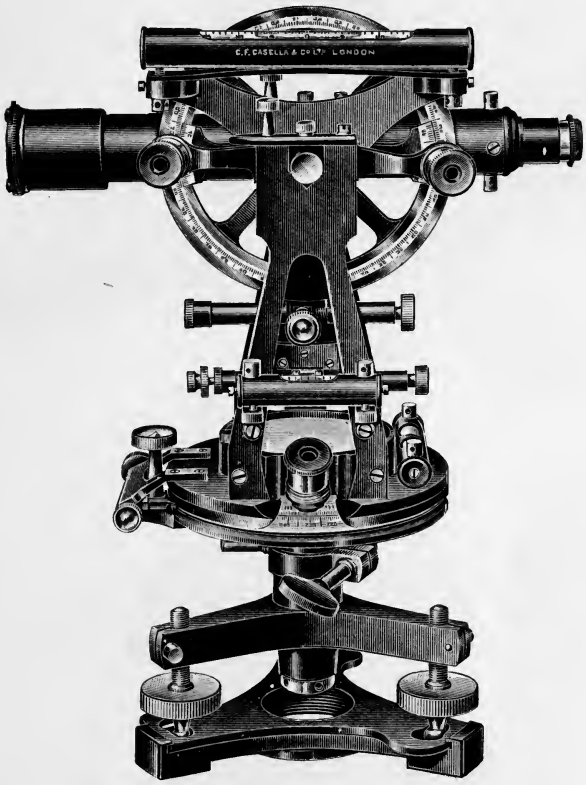
(6A) **Special Portable Stand**, with jointed legs, for either of the above instruments ... ...extra **£1 10 0**

(7) **3**-inch **Transit Theodolite**, vertical and horizontal circles reading by verniers to 1 minute, readers, compass, rack adjustment, best achromatic telescope; with level, diagonal, erect and inverting eye-pieces, cross levels, spring tangent screw and clamp adjustments, locking or parallel plates, in mahogany case, with tripod stand, complete **£22 10 0**

Weight of instrument, case and stand, 15 lbs. (6·8 kilos).

(8) **4**-inch **Transit Theodolite**, vertical and horizontal circles reading by verniers to 1 minute, readers, compass, rack adjustment, best achromatic telescope; with level, diagonal, erect and inverting eye-pieces, cross levels, spring tangent screw and clamp adjustments, locking or parallel plates, in mahogany case, with tripod stand, complete **£24 10 0**

TRANSIT THEODOLITES—Continued.



No. 8.

4-inch Transit Theodolite.

(9) **5**-inch Ditto, to 1 minute **£26 10 0**

(10) **5**-inch Ditto, to 30 seconds **£28 0 0**

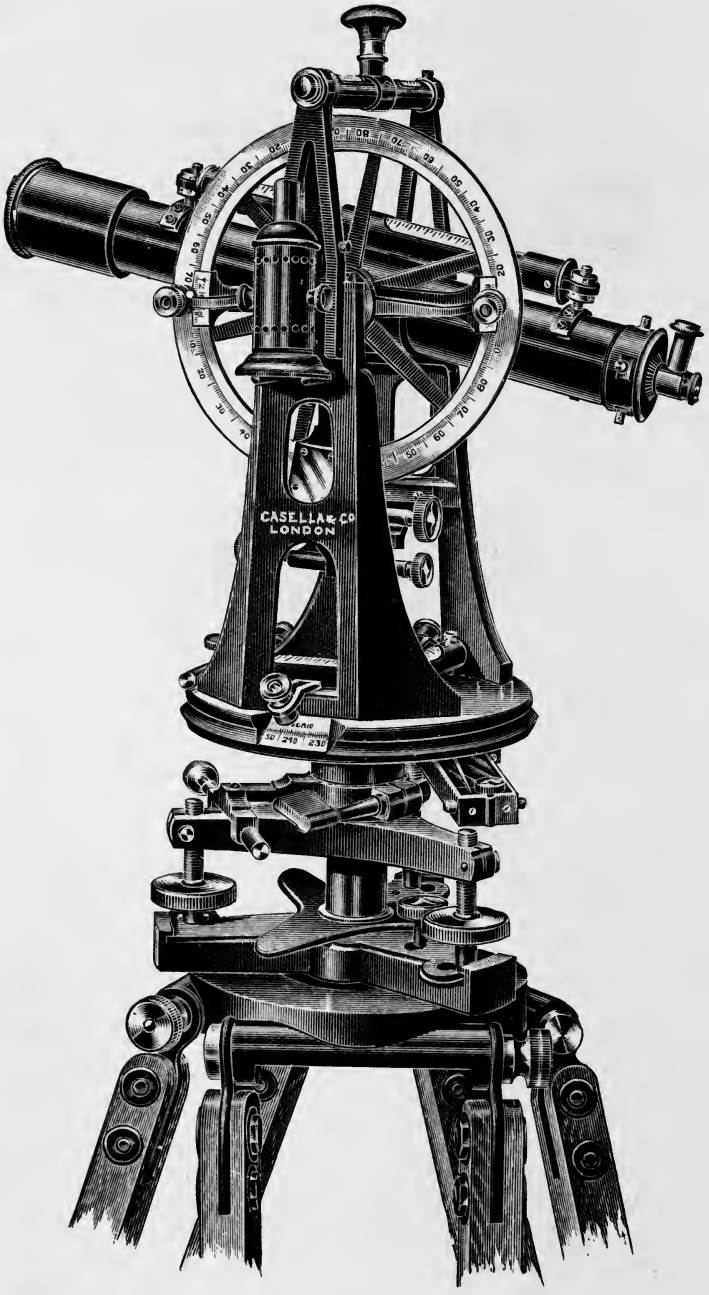
(11) **6**-inch Ditto, to 20 seconds **£30 0 0**

(6 inch, to 10 seconds, 40s. extra.)

(12) **7**-inch **Transit Theodolite**, to 10 seconds, as the 6-inch above, with illuminated axis, stride level, lamp, locking plates, etc., in case, with extra strong lath stand, complete **£45 0 0**

(13) **8**-inch Ditto (see fig. 13, page 4) **£60 0 0**

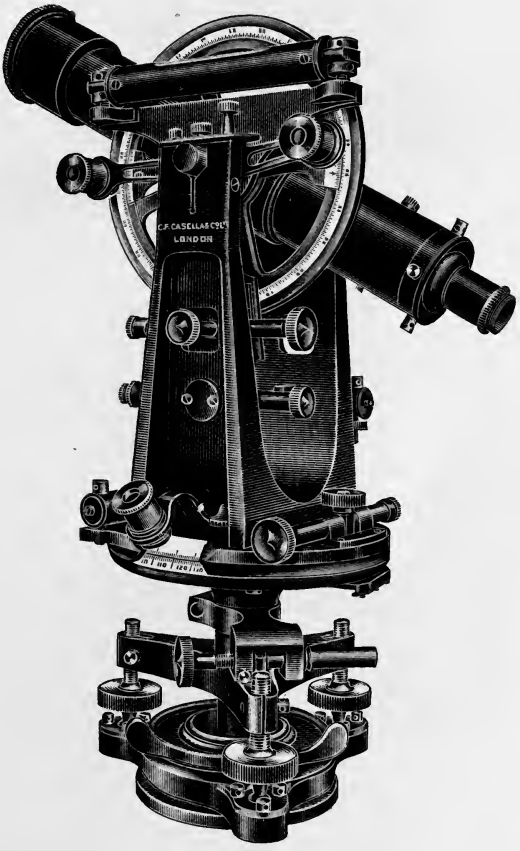
☛ Larger sizes and special patterns made to order.



No. 13.

8-inch Transit Theodolite.

TRANSIT THEODOLITES—Continued.



No. 14.

(14) **4**-inch **Transit Theodolite**, similar to No. 8, but with the standard and centre made of one casting, with strengthening webs, reading to 30 seconds **£26 0 0**

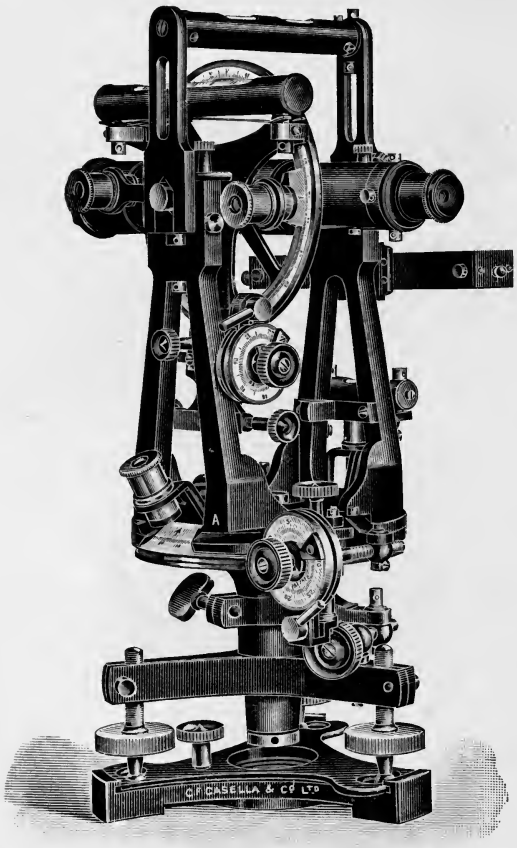
(15) **5**-inch Ditto, to 30 seconds **£28 0 0**

(16) **6**-inch Ditto, to 20 seconds **£30 0 0**

Centering head as shown in fig. 14 ... ... extra, from **£1 2 6**

For other accessories, see page 14.

TRANSIT THEODOLITES—Continued.



No. 17.

(17) **4**-inch **Transit Theodolite,** best construction, with vertical and horizontal circles, divided on silver to 1 minute, fitted with **Reeves's patent tangent micrometers** to both circles, best achromatic telescope, stride level, bubble on vernier arm divided to 10 seconds, trough compass with reversible needle, erect, inverting and diagonal eye-pieces, improved form of end illuminator for the webs, 3 sun glasses, etc.; in mahogany case with round tripod stand, complete... ... ... **£36 0 0**

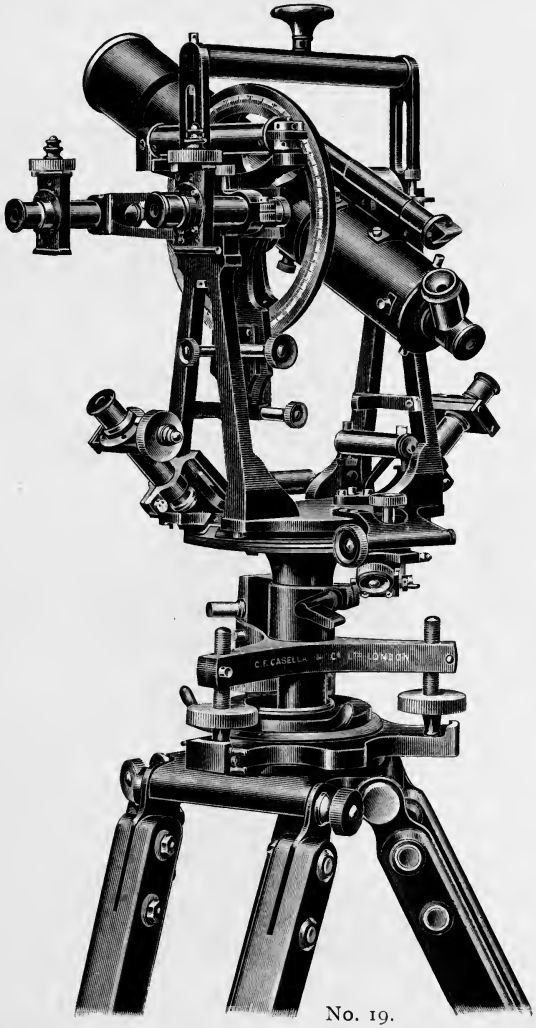
By means of these micrometers the angles can be read to 10 seconds, and estimated to 5 or 2½ seconds. The instrument described above, though it has only 4-inch circles, is as accurate as a 6-inch theodolite with ordinary verniers. It has been very carefully designed in all particulars, and will be found to possess several improvements over the usual type of transit theodolite.

Among the purchasers of this pattern may be mentioned—The Royal Geographical Society; Sir Ernest Shackleton, C.V.O. (British Antarctic Expedition, 1907).

For fuller information on Reeves's Patent Micrometers, see page 11.

TRANSIT THEODOLITES—Continued.

(18) **5**-inch **Transit Theodolite,** fitted up exactly as No. 17, with Reeves's patent micrometers to both circles. Reading to 10 seconds **£40 0 0**



No. 19.

(19) **5**-inch **Transit Theodolite**, with **micrometers** to vertical and horizontal circles, circles divided to 1 minute and reading by the micrometers to 5 seconds, trough compass (6-inch needle), illuminated axis, lamp and bracket, spring tangent screws, best achromatic telescope, stride level, bubble on vernier arm; erect, inverting and diagonal eyepieces, spare diaphragm in brass box; centering head; complete in mahogany case with open framework stand **£54 0 0**

(20) **6**-inch Ditto **£57 10 0**

AMERICAN PATTERN THEODOLITES

We make **theodolites and levels** designed on the **American lines** for many of our customers, and will be glad to submit prices and illustrations to surveyors who prefer these instruments to the English models

TACHEOMETERS

A tacheometer is a transit theodolite modified for use in measuring small angles and thus serving as a telemeter. The essential difference between the two instruments is that the tacheometer is provided with stadia lines on the diaphragm and an anallatic lens in the eyepiece of the telescope. The stadia lines are usually spaced to read 1 in 50 between the outer pair and 1 in 100 between the inner pair. The anallatic lens is a supplementary lens in the eyepiece provided for the purpose of dispensing with the " constant " of the telescope.

(21) **4**-inch **Tacheometer**, vertical and horizontal circles, divided either to 30 minutes and reading by verniers to 1 minute, or centesimally. Telescope with object-glass 8-inch focal length and 1·125-inch aperture and anallatic lens; level on telescope and on vernier arm; three screws and locking plate, two eyepieces (high and low power), trough compass and usual accessories; in mahogany case with solid tripod stand, complete ... **£32 0 0**

(22) **4**-inch Ditto but with light telescopic tripod stand, No. 73, illustrated on p. 24 ... ... **£34 0 0**

(23) **5**-inch Ditto, as No. 21, but with larger telescope (10-inch focal length, 1·35-inch aperture), and reading to 30 seconds (or corresponding centesimal reading). With centering head, solid or open framework stand ... **£36 0 0**

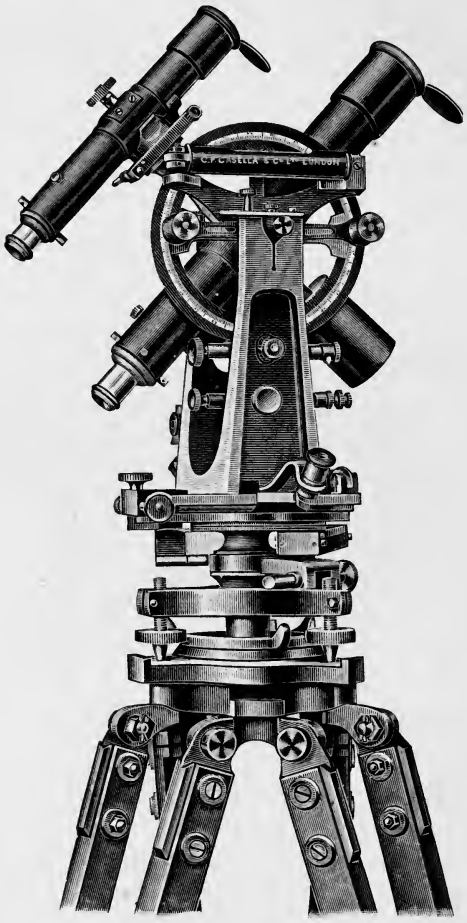
(24) **6**-inch Ditto, as No. 23, but with object glass 12-inch focal length and 1·6-inch aperture. Reading to 20 seconds (or centesimally). With open framework stand and centering head. Packed in two mahogany cases... **£41 0 0**

Kew certificates for theodolites and tacheometers, price from **16/0** each according to size.

For **slide rule** for tacheometrical work, see No. 320.

See also Reeves's Distance Finder—Alidade, No. 75.

MINING THEODOLITES



No. 25.

(25) **Mining Transit Theodolite,** with additional telescope, which can be attached either at the side of the main telescope or directly above it, giving a clear vertical sight downwards in either position; with slow-motion adjustment and clamp for setting the single wire of the interchangeable telescope accurately in the line of collimation of the main telescope; inverting and diagonal eyepieces, two reflectors, counterpoise for supplementary telescope; in mahogany case, with telescopic tripod stand, complete **£42 0**

MINING THEODOLITES—Continued.

(26) **Lamp**, copper, non-magnetic, for mining work **£1 2 6**

(27) **Stand** for the same, telescopic, with 3 screws or parallel plates, in case **£4 15 0**
(Cheaper stands from £3 0 0).

(28) **Combined Plumb Bob and Lamp** **£1 12 6**

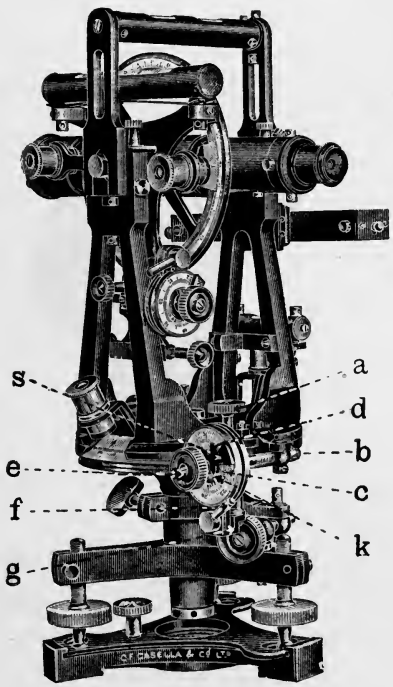
INTERCHANGEABLE STANDS FOR TUNNELLING WORK

We shall be glad to send particulars and prices to engineers engaged on tunnel work of interchangeable stands to carry the telescope and vertical arc of a transit theodolite.

(29) REEVES'S TANGENT MICROMETER

(Patent No. 5960, 1905).

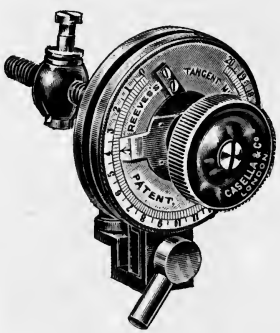
Sole Makers: C. F. CASELLA & Co., LTD.



For Reading the Arcs of Surveying and Astronomical Instruments.
Can be readily fitted to any pattern instrument.

REEVES'S TANGENT MICROMETER—Continued.

The most important instrument for the geographical surveyor is doubtless the transit theodolite; but this instrument in early explorations was rarely carried, as it was generally considered to be too heavy and bulky. The smaller vernier theodolites reading only to 30 seconds or even 20 seconds are not sufficiently accurate for astronomical observations, and to take a larger instrument was usually out of the question on small expeditions. Recently, instead of the ordinary verniers, micrometers have been more commonly fitted to theodolites, and these greatly increase the accuracy of reading. But the micrometers hitherto fitted, and the projecting arms upon which they are carried, make the instrument very bulky, besides which, they are liable to be deranged and put out of adjustment. These reasons, together with the considerable additional cost owing to the necessity of constructing four separate micrometers, have led Mr. E. A. Reeves, F.R.A.S. (Curator and Instructor in Practical Astronomy and Surveying to the Royal Geographical Society), to devise a micrometer for theodolites which, while giving considerable accuracy of reading, is simpler, not so liable to be put out of adjustment and less expensive than the ordinary form.



No. 29.

The figure on the previous page shows the micrometer fitted to a four-inch transit theodolite, rendering it possible to estimate with ease to the nearest **2** seconds on both the vertical and horizontal circles. **a** is a clamp screw of the ordinary pattern, and **b** the tangent screw, turned by the milled head **e**, for making the exact contact of an object on the intersection of the cross-hairs in the telescope. The tangent screw **b**, which is specially constructed for the purpose, carries the pointer **d** and the micrometer

REEVES'S TANGENT MICROMETER—Continued.

drum, the central part **k** of which, with the pointer **d**, is rigidly attached to the tangent screw. The outer rim or dial **c**, upon which are engraved the numbers representing single minutes or tens or fives of seconds of arc, also carried by the tangent screw, is separate, and only attached to the central part **k** by a spiral spring inside the drum. By means of this spring the outer rim or dial **c** is, in its normal position, kept with the zero, opposite the pointer **d**, which is effected by the stop **s**, attached to the dial **c**, being pressed by the spring against the pointer **d**. **g** is a clamp actuated by the lever **f** by means of which the dial **c** can be firmly held in any position; in which case, when the tangent screw is turned, the pointer **d** revolves without moving the dial **c**, and points to any required number on the dial. However, immediately the clamp **g** is released, the dial, actuated by the spiral spring, returns to its normal position with the zero opposite the pointer.

Instead of a vernier, the upper plate carries a fine pointer, which serves as an indicator as in the ordinary theodolite micrometer. There are two of these indicators, 180° apart, and reading microscopes for setting them.

To use the Micrometer: When the clamp **g** is released, the pointer **d** remains at zero, the tangent screw, dial and pointer all turn together, and the screw acts exactly as an ordinary tangent screw. Therefore, with the clamp **g** released, make the contact of a star or terrestrial object in the ordinary manner, adjusting finally with the tangent screw. To take the reading, first clamp the dial **c**, and, looking through the reading glass, it will be seen that the pointer is somewhere between two marks on the arc. Now turn the milled head **e** of the tangent screw until, looking through the reading glass the arrow points exactly to the preceding minutes mark, or that next less in reading than the position in which it stood when the contact of the object was made.

The complete reading will then be the reading on the arc, plus the minutes and seconds of arc on the micrometer drum, as shown by the pointer **d**, as in the case of the ordinary micrometer. Both "A" and "B" readings can be taken by the same micrometer, for having taken the "A" reading as shown here, look through the other reader and take the "B" reading in exactly the same manner.

Any reading can be set upon the arc by reversing the above operation. To do this, first set the arrow to the preceding minutes mark on the arc, then turn the drum of the micrometer until the pointer **d** indicates the required odd minutes and seconds. When this is done,

REEVES'S TANGENT MICROMETER—Continued.

clamp the drum of the micrometer and turn the tangent screw in the opposite direction to that for ordinary reading until the pointer **d** is at zero on the micrometer drum.

The micrometer is equally applicable to sextants, and in fact to all instruments for the exact reading of angular measurements.

Price when added to 4 inch theodolite, extra, per pair ... **£7 0 0**
,, ,, 5 ,, ,, ,, ,, ... **£7 10 0**
,, ,, 6 ,, ,, ,, ,, ... **£8 0 0**

Cost may vary according to pattern of instrument.

Quotations given for fitting this patent attachment to any instruments.

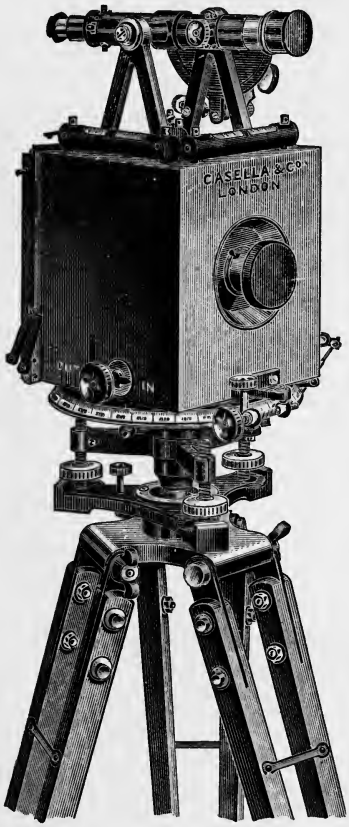
ACCESSORIES FOR THEODOLITES

(30) **Shifting or Centering Head** ... ... from **£1 2 6**
(31) **Hoffman Head** ... ... ,, **£1 8 6**
(32) **Illuminated Axis,** with lamp and bracket ... ,, **£1 10 0**
(33) **Stride Level** ... ... ,, **£1 2 6**
(34) **Eyepiece,** inverting ... ... ,, **£0 6 0**
(35) Ditto, erecting ... ... ,, **£0 10 0**
(36) Ditto, diagonal ... ... ,, **£0 16 0**
(37) **Sun Glass** ... ... ,, **£0 2 6**
(38) **Diaphragm,** ordinary, glass or webs ... ... ,, **£0 7 6**
(39) Ditto, glass, with stadia lines ... ... ,, **£0 10 6**
(40) Ditto, platinum-iridium points ... ... ,, **£0 12 6**
(41) **Bubbles,** set of, in brass tubes ... ... ,, **£0 18 6**
(42) **Plumb Bob,** with cord, various sizes ... ... ,, **£0 3 0**

Tripod Stands, see p. 24.

Leather and Canvas Cases, see p. 25.

(43) **PHOTO-THEODOLITE**



No. 43.

The principle of the photo-theodolite and its general appearance are shown in the illustrations; Fig. 43A, however, is not quite accurate now, as several improvements and modifications have been introduced into the design since this instrument was first constructed.

The photo-theodolite is designed to give true photographic perspectives in a vertical plane, and at constant distance, and is furnished with special mechanism for recording on the negative the information necessary for interpreting the photographs and plotting the ground plans.

PHOTO-THEODOLITE—Continued.

No. 43A.

It has been conclusively demonstrated on a very large scale that for hilly and mountainous districts the photographic method is superior to all others. It has been proved to be very much quicker and cheaper than any other known method, and also more convenient and at least as accurate.

PHOTO-THEODOLITE—Continued.

Our photo-theodolites have been used with notable success in all parts of the world. In Canada, India, South America and Japan many thousands of miles have been surveyed in this manner.

The price of the instrument, with a good lens, and complete with dark slides, isochromatic screen, etc., is ... **£45 0 0**

☞ *For fuller particulars see* **special handbook** *on this subject.*

LEVELS

No. 44.

(44) **12**-inch **Y Level,** improved pattern, best achromatic telescope, rack motion to object end; erect and inverting eye-pieces, key adjustments, *without compass*, ground level tube divided to tenths, locking plate and 3-screw adjustment, in mahogany case, with round tripod stand, complete **£12 0 0**

(45) **14**-inch Ditto with rack to both eye and object ends ... **£14 0 0**

(46) **16**-inch Ditto **£16 0 0**

(47) **18**-inch Ditto, with rigid **open framework stand** ... **£22 0 0**

Silvered Dial Compass for any of the above, extra ... **£1 10 0**

LEVELS—Continued.

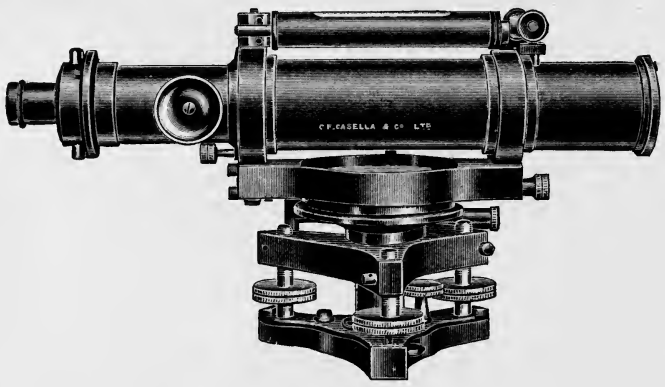
(48) **12**-inch **Dumpy Level**, improved, best achromatic telescope with rack motion, without compass; two eyepieces, reflector, three screws and locking plate or with parallel plates, etc., in case, with tripod stand, complete **£11 0 0**

(49) **14**-inch Ditto **£13 0 0**

(50) **16**-inch Ditto **£15 0 0**

(51) **18**-inch **Dumpy Level**, with extra large telescope, 2-inch object glass, and 5-inch compass, etc., as above. Price on application.

Silvered Dial Compass for any of the above, extra ... **£1 10 0**



No. 52.

(52) **12**-inch **Cushing's Reversible Level**, greatly improved, with locking plate; in case, with solid stand, complete... **£13 10 0**

(53) **14**-inch Ditto, with solid or lath stand **£14 10 0**

Silvered Dial Compass for either of the above, extra ... **£1 10 0**

(54) **9**-inch **Builder's or Drainage Level**, compact model, with 3-screw adjustment and long bubble, in pine case, with round tripod stand **£7 10 0**

(55) **9**-inch Ditto, lighter pattern... ... ... **£4 10 0**

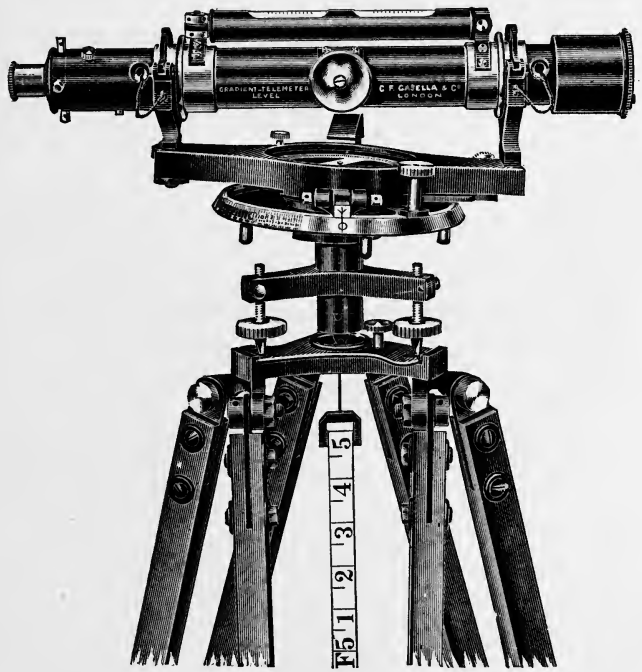
(56) **8**-foot **Levelling Staff**, one fold, for use with either of the last two instruments **£1 0 0**

See also Nos. 164 to 173.

THE GRADIENT-TELEMETER LEVEL

A new pattern, a great improvement on the original design.

In this instrument, as shown in the illustration below, are embodied by an ingenious construction, all the means necessary for **taking gradients, measuring or setting out distances, and obtaining differences in level**, all of which are performed, in an extremely simple and rapid manner, by one and the same observation. With the gradient-telemeter level the necessity for using a land chain or tape is entirely



No 57.

removed, and as the operations are performed with singular accuracy, rapidity and ease, a much greater quantity of work can be done in a given time than with the usual methods employed by surveyors and civil engineers.

The linear distances can be obtained far more accurately than with the land chain, and this regardless of rough and broken ground, or the existence of a stream or other water, between the observer's station and the distant object.

THE GRADIENT-TELEMETER LEVEL—Continued.

A marked advantage with this instrument, and one that renders it particularly attractive when employed in the field, is that there are *no calculations* to be made in connexion with its use; there is no *fine micrometer screw* to work, with its certain errors and elaborate calculations; there are no moving etched or spider lines which soon get broken, thus rendering the instrument useless until it can be returned to the maker to be set right; but, by a single revolution or movement on the axis of the instrument and an observation through the telescope, the gradient, distance or difference of level is at once obtained.

This distinguishing feature, *i.e.*, that it is **not in accessories**, which are always liable to get out of adjustment, but in the **essential simplicity** of its principle that its merits lie, makes this a really valuable instrument for practical use in the field; and for the same reason—owing to the removal of many possible sources of error—the accuracy of the results obtained may be absolutely relied upon.

We have supplied numbers of gradient-telemeter levels to surveyors and engineers, not only in England, but in the United States, Canada, Spain, Portugal, and indeed in almost every part of the world, and have received the most convincing proof of its efficiency as an accurate, time-saving instrument, in the large number of letters acknowledging its merits, and, above all, in the many repeat orders which have been sent to us.

PRICES

(57) **Gradient-Telemeter Level,** 14 inch, with compass, locking plate, three screws, graduated to gradient 1 in 10, in case complete, with open framework stand ... **£22 0 0**

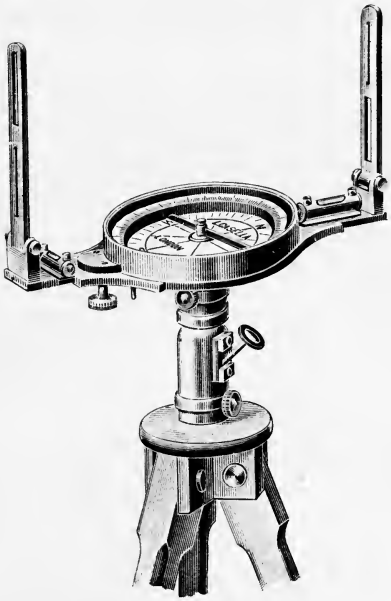
~~(58) Ditto ditto 12 inch size ... ... £21 0 0~~

~~(59) Ditto ditto 16 inch size ... ... £25 0 0~~

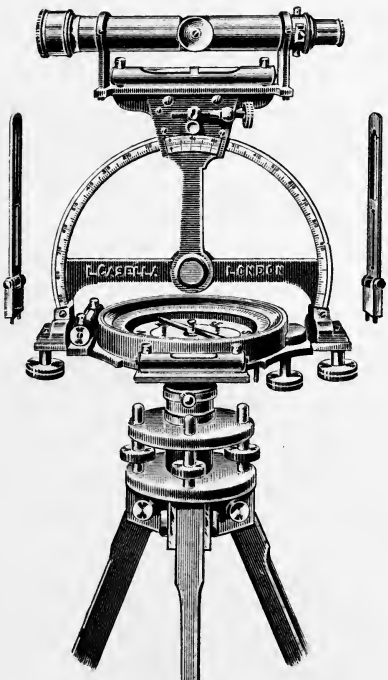
EXTRAS.—If provided with **theodolite limb** divided on silver, with two verniers and readers, for 14 inch, £11 10s.; 12 inch, £9 15s.; 16 inch, £13.

Shifting Base Plate for centering the instrument accurately over a given point **£3 10 0**

For further particulars see our pamphlet on The Gradient-Telemeter Level, in which will be found full instructions and several examples of the methods of working the instrument.



No. 63.



No. 64.

CIRCUMFERENTORS

(60) **4**-inch **Circumferentor**, plain dial, plain compass, no levels; in case, with stand complete **£6 0 0**

(61) **5**-inch Ditto, plain dial, divided compass, with case and stand, complete **£7 15 0**

(62) **5**-inch Ditto, with folding sights, divided circle to compass, cross levels, etc. **£9 0 0**

(63) **6**-inch Ditto, with folding sights, rack adjustments, divided compass, vernier reading to 3 minutes, cross levels, ball and socket joint and jointed legs (see fig., p. 21) **£11 10 0**

(64) **5**-inch Ditto, improved, with telescope, rack adjustment, graduated arc, vernier reading to 3 minutes, cross levels and shifting folding sights, etc., etc., with jointed stand and parallel plates, in two cases (see fig., p. 21) **£16 0 0**

(65) **6**-inch Ditto, with all improvements, as above **£17 0 0**

MINING DIALS

(66) **Headley's Dial**, greatly improved, with telescope and quadrant; with raised divided circle and rack motion to vernier; reading to minutes; cross levels; round jointed stand, improved ball and socket adjustment, with spare points to use at half-length, in separate case (see fig., page 23) **£18 18 0**

(67) Ditto, with sights instead of telescope **£14 14 0**

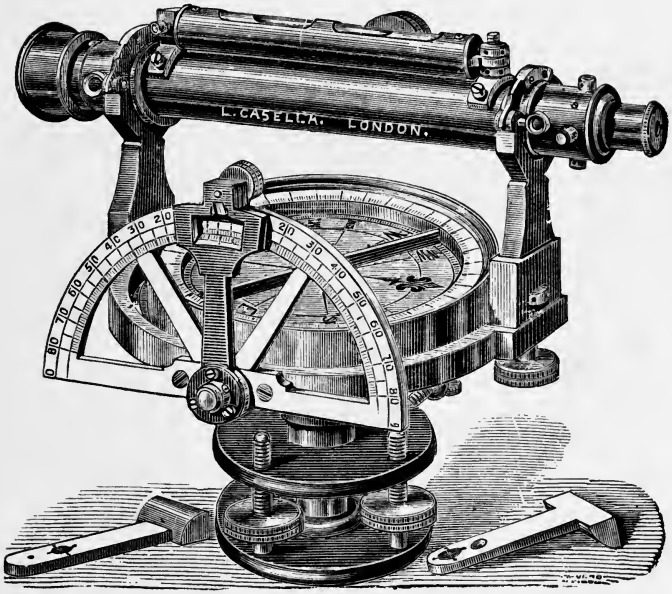
(68) **Headley's Dial,** telescope fitted in Y's, circular compass, with cross levels mounted inside it, vertical arc reading to three minutes, clamp and tangent screw, four screws and parallel plates or ball and socket head, with sliding stand, complete with all accessories, in mahogany case.

	5 inch.	6 inch.
Inside reading	**£20 15 0**	**£22 10 0**

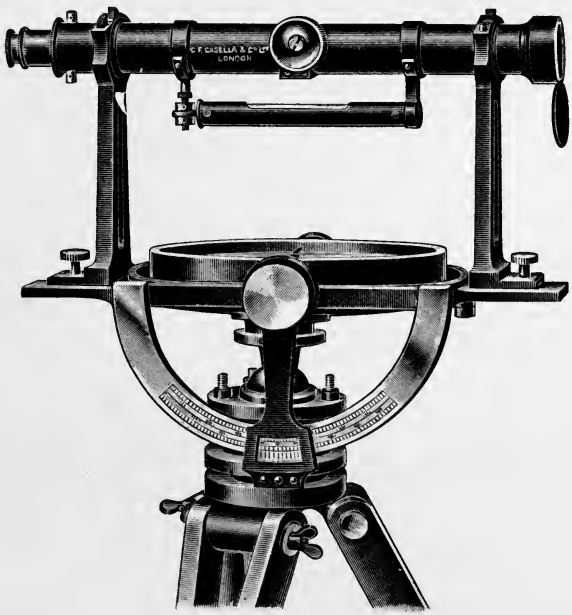
(69) Ditto, as figure, p. 23, **outside reading** ... **£22 10 0** **£24 0 0**

If **sights** are desired instead of a telescope, the above prices will be reduced by £4 5 0.

MINING DIALS—Continued.



No. 66.

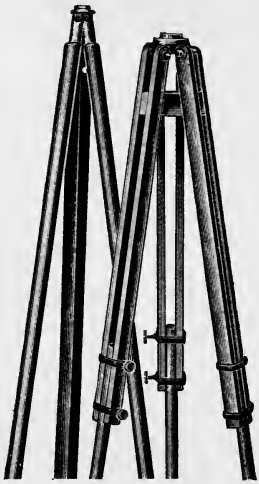


No. 69.

TRIPOD STANDS

No. 70.

No. 71.



No. 72. No. 73.

(70) **Mahogany Tripod**, open framework, with centering head and locking plate attached.

For 4 inch	5 inch	6 inch theodolite.
£4 7 6	**£5 2 6**	**£5 15 0**

Without locking plate, £1 2 6 less.

(71) **Mahogany Tripod**, solid, round.

For 4 inch	5 inch	6 inch theodolite.
£2 5 0	**£2 12 6**	**£3 0 0**

(72) Ditto, lighter pattern, for levels, etc.

Prices **£2 2 0** to **£3 7 6**

(73) **Mahogany Tripod**, telescopic; a very rigid, yet light, model.

For 4 inch	5 inch	6 inch theodolite.
£3 10 6	**£3 15 6**	**£4 0 0**

See also Nos. 132 and 133.

Cheaper tripods, such as camera stands, also supplied.

LEATHER AND CANVAS CASES

(74) **Leather and Canvas Cases.** In place of leather we now frequently supply cases of green Willesden canvas. This material, being very strong and absolutely rot-proof, is recommended for rough wear in trying climates.

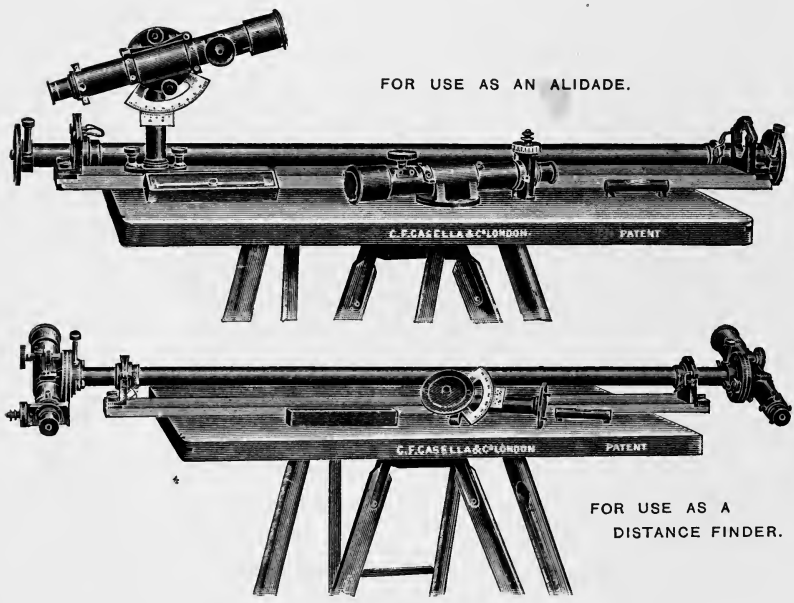
	BEST QUALITY BROWN LEATHER SLING CASE, PADDED WITH HORSE-HAIR AND GREEN BAIZE.	GREEN ROT-PROOF CANVAS SLING CASE, PADDED WITH HORSE-HAIR AND GREEN BAIZE.
	£ s. d.	£ s. d.
For 3-inch Theodolite	3 0 0 ...	2 5 0
„ 4-inch „	3 4 0 ...	2 10 0
„ 5-inch „	3 7 6 ...	2 13 6
„ 6-inch „	3 13 6 ...	3 0 0
„ Photo-Theodolite	7 6 6 ...	6 0 0
	(1 sling, 1 knapsack case)	
„ Gradient-Telemeter Level	3 4 0 ...	2 10 0
„ 12-inch Level	3 0 0 ...	2 5 0
„ 14-inch „	3 4 0 ...	2 10 0
„ 16-inch „	3 7 6 ...	2 13 6
„ 18-inch „	3 13 6 ...	3 0 0

☛ Cheaper quality cases than those listed above can be supplied if desired, at a reduction in price of 25%; but for hard wear, especially in tropical climates, we strongly recommend the more expensive ones.

(75) REEVES'S DISTANCE FINDER—ALIDADE

(Patent No. 19775^{06}.)

Sole Makers: C. F. Casella & Co., Ltd.



No. 75.

(Since the above illustration was drawn this instrument has been improved by making the **aluminium bar of triangular section** instead of flat, thus increasing its rigidity and accuracy.)

In geographical and other survey work it is often of great assistance to be able to obtain distances rapidly without actual measurement upon the ground, and without having first to set off a known distance as a base, which is the case with many telemeters. Other existing instruments for this purpose, depending upon the angle subtended by a short rod, are either too liable to be put out of adjustment, owing to derangement of prisms and change of temperature, or necessitate the sending of an assistant with a rod to the point of which the distance is required.

REEVES'S DISTANCE FINDER—ALIDADE—Continued.

Ordinary tacheometers, by which distances up to 400 to 500 feet are read off a graduated staff, and the bar-subtense instrument, are of the latter class, and, though excellent in their way, the necessity of sending a man with a rod is often most inconvenient, and naturally *limits their use to accessible positions*. What is wanted is an instrument of the same character, *strong* and *simple* in construction, not liable to inaccuracies through the derangement of adjustments, and *without the necessity of a separate rod*, so that the distances of inaccessible as well as accessible points can be quickly measured with sufficient accuracy for practical purposes, and the "Distance Finder," here shown, has been specially designed to meet these requirements.

As will be seen, this instrument consists of a rod of a certain fixed length, revolving in collars and carrying two telescopes, one at each end.

The telescopes are similar in general appearance, but while in the diaphragm of one there are only a fixed vertical wire and a horizontal wire, to the other, in addition to these, is fitted a micrometer, by means of which a second vertical wire can be moved across the diaphragm.

The system of taking observations for obtaining the distance of an object is so arranged that by repeating the measurement with the rod and telescopes in different positions, errors in vertical and horizontal parallelism, as well as in collimation, are eliminated, so that should the adjustments be deranged, or the rod become slightly flexed by any means, the errors are detected and made to balance each other, and the mean of the observations will give the correct distance. *This is a most important feature in the instrument, and renders it suitable for use under rough conditions.*

Upon the side of the bar will be found a scale of divisions and corresponding distances in feet, which, to ensure accuracy, is constructed from actual measurements of known distances. The distance it is possible to measure with this instrument will, of course, depend principally upon the length of the rod, the accuracy with which observations are made, and the number of repetitions to obtain a good mean. However, in this respect it compares favourably with the bar-subtense instrument now in use, while much longer distances can be measured than with the ordinary tacheometer with fixed wires in the diaphragm, and used in conjunction with a graduated rod. With the latter instrument, 400 to 500 feet is considered a long shot, but with this distance finder, even with a short rod of only three feet, a distance of 1,200 feet with an error of about 0·4 per cent. has been obtained, and very fair approximations of longer distances. For shorter distances the same rod

REEVES'S DISTANCE FINDER—ALIDADE—Continued.

naturally gives much nearer results, while with rods of greater length longer distances and greater accuracy could, of course, be obtained.

The instrument can be taken to pieces and carried in parts to render it portable. The distance of a moving object could be obtained by meaning or, better still, by having an observer at each telescope.

Combined with a simple plane table this distance finder, with a three-foot rod, can be made to give distances up to 4,000 or 5,000 yards with very fair accuracy without necessarily changing the position of the instrument on the ground. This can be accomplished in different ways, as follows:

Fig. 1.

1st Method.—Let A (Fig. 1) represent the observer's position, and B the point on the ground of which the distance is required. Place rods at C and D in a straight line with B, and as far off from the plane table, x, y, as possible, so long as the distance both to C and D comes well within the range of the distance finder. Standing now at the plane table, sight on B, C and D, and rule lines towards these points. Next, with the distance finder, measure the distances to the rods C and D, and set these measures off on the lines drawn towards these rods, using a diagonal scale of feet or yards. A c and A d represent these measures on the plane table. Now carefully place the edge of the distance finder-alidade on the points c, d, and draw a fine line which will intersect the line previously drawn from A towards B, at the point b. The distance A b, carefully taken with a pair of compasses from the diagonal scale, will be the distance of the point B from the plane table at A.

By this method the distances to several points for many degrees round the horizon line can often be fixed without changing the position of the plane table and by moving only one of the rods placed in the ground at C and D. The distance of the other rod will then be a constant and the work will thus be considerably shortened. Distances can be very rapidly measured in this manner, especially when an assistant is employed to place the rods in a line with B, the point to be fixed.

REEVES'S DISTANCE FINDER—ALIDADE—Continued.

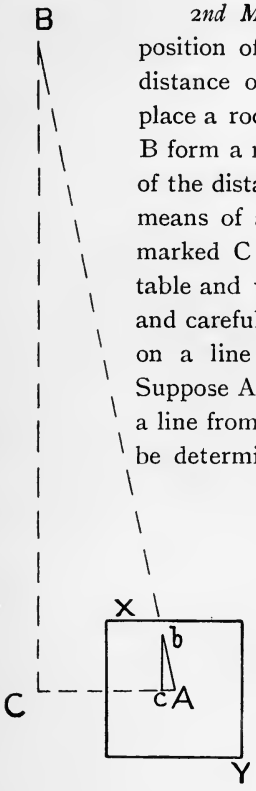


FIG. 2.

2nd Method.—Here, again, let A (Fig. 2) represent the position of the plane table, and let it be desired to find the distance of a point B. Leaving the plane table, x, y, at A, place a rod in the ground at the position C, where A, C and B form a right angle, and at a distance well within the range of the distance finder. This position can be readily found by means of a small optical square held in the hand. Having marked C on the ground by a rod, pass back to the plane table and with the distance finder measure the distance A C, and carefully mark it off from a diagonal scale of feet or yards on a line drawn on the plane table from A towards C. Suppose A c to represent this measured distance. Next draw a line from A towards B, the point of which the distance is to be determined, and at c set up a line drawn at right angles to A C, which will intersect the line previously drawn at b. The distance A b, carefully measured with a pair of compasses from the diagonal scale on the plane table, will give the distance of the point B from the plane table at A. When an assistant can be employed to set up the rod at C, the distance can be obtained very quickly, and with care, with considerable accuracy.

When the plane table can be moved without inconvenience, long distances can be measured as in ordinary plane tabling, using the distance finder-alidade to obtain the length of the base or traverse line.

A good plane table sketch of a considerable area of country can be made in a very short time by using the distance finder-alidade, the distances to the mean points being obtained directly with the instrument, and those to the more distant positions as here shown.

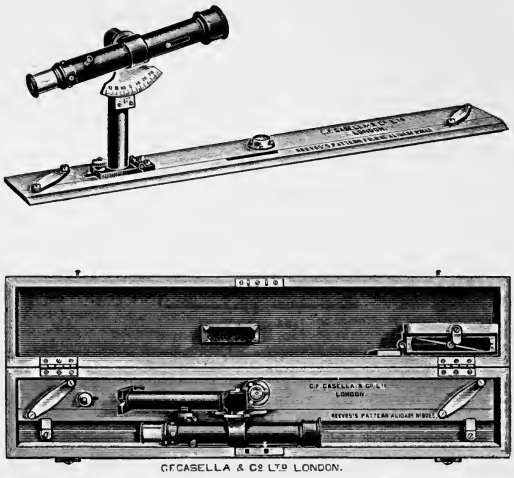
Another great advantage of the distance finder-alidade is that the surveyor can readily find his position on the plane table when fixed points are laid down. By orienting by the compass needle this can be done with one fixed point only by reversing the operation in the second method.

Price, with three-foot base, complete with trough compass, level, etc., in case ... ... from **£35 0 0**

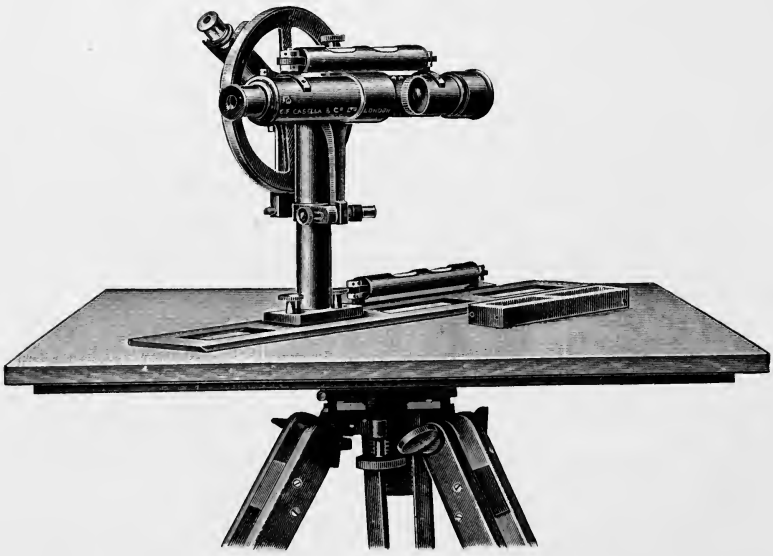
Canvas Sling Case, best quality, extra ... ... ,, **£1 15 0**

For Plane Tables, see pp. 31 and 32.

ALIDADES



No. 76.



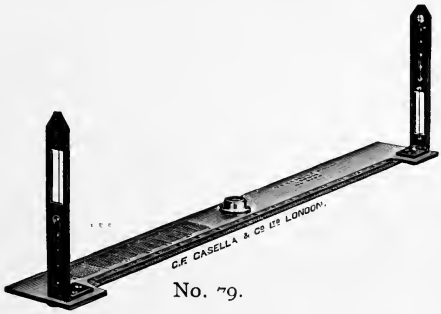
No. 77.

ALIDADES—Continued.

(76) **Reeves's Pattern Folding Alidade,** with telescope, vertical arc reading to 5 minutes. The telescope is mounted on a stout brass bar with parallel rule attachment, and the pillar to which it is fixed is arranged to fold flat so that the instrument can be packed into a compact case. The whole forms an extremely neat, portable, but at the same time strong alidade, and is particularly recommended for explorers and travellers. Price, in mahogany case. (See figure, page 30) **£6 6 0**

If with diagonal and other scales engraved on the rule **£7 7 0**

(77) **Alidade, metal,** 18 inch, with telescope, vertical arc reading by vernier to 30 seconds, trough compass, levels on telescope and on base, as shown in figure; in mahogany case. (See figure, page 30) **£14 10 0**



No. 79.

(78) **Alidade, metal,** 16 inch, with telescope, but without vertical arc, in case (as shown in Fig. 86)... ... ... **£3 5 0**

(79) Ditto, **metal,** 18 inch, with folding metal sights, cross levels, rule engraved with diagonal and other scales; in mahogany case **£2 7 6**

(80) **Polished Mahogany Case,** to hold metal alidade from **£0 6 0**

(81) **Alidade, boxwood,** with metal sights, in mahogany case **£0 18 6**

(82) **Trough Compass,** best quality, metal, in mahogany case with sliding lid ... ... 4 inch, **18**s. **0**d.; 6 inch **£1 4 0**

(83) **Trough Compass,** cheaper quality, in wooden frame ... **£0 6 6**

(84) **Spirit Level,** best quality, 4 in., divided bubble **£0 17 6**

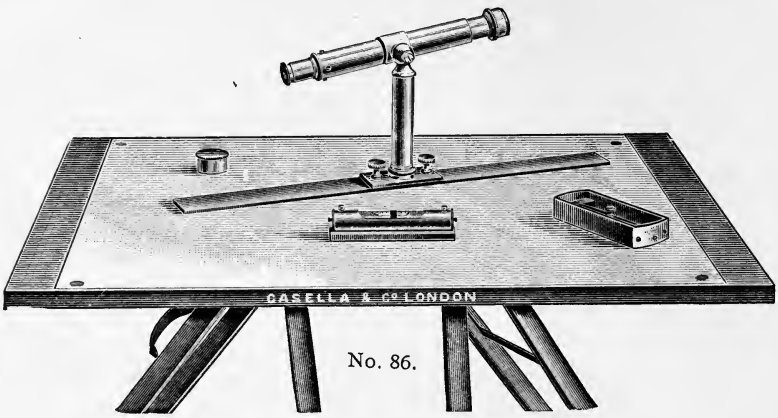
(85) Ditto, cheaper ... ... **4**s. **6**d. and **£0 3 0**

PLANE TABLES

(See also page 113).

(89) **Plane Table,** ebony-edged grooved board, brass-sloted mahogany battens to prevent warping, fitted with Casella's **specially rigid tripod head**; with rule-jointed folding stand; 27 in. × 18 in. or 23 in. × 16 in.... **£3 3 0**

PLANE TABLES—Continued.



No. 86.

(Showing alidade No. 78.)

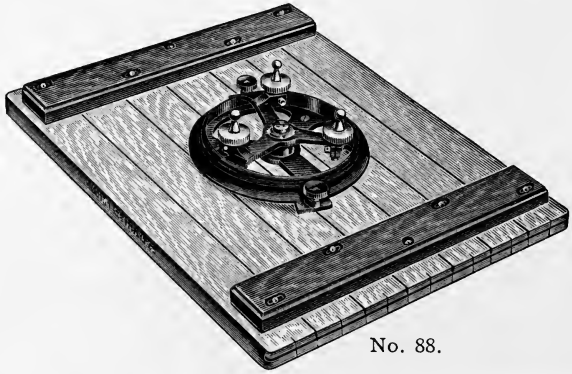
(87) Ditto, with sliding and folding stand **£3 18 6**
(As supplied to Oxford University, The Royal Geographical Society, etc.)

Extras for the above

(88) **Levelling Screws** fitted to head (see fig. below) extra **£4 10 0**

(89) **Clamp and Tangent Screw** ... ... ,, **£3 0 0**

(90) **Rot-Proof Canvas Case**, best quality, to hold board and tripod-head, with pockets for maps, sketch books, level and compass, with shoulder strap ... ... from **£1 17 6**



No. 88.

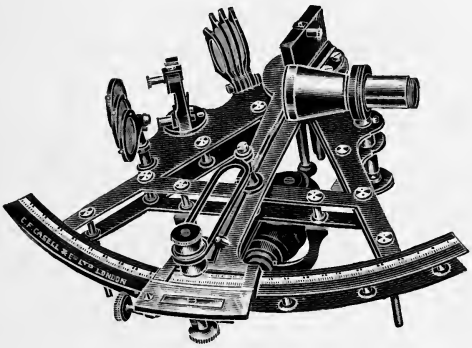
(91) Ditto, to hold tripod stand ... ...from **£0 15 6**

(92) **Leather Straps and Handle**, for tripod stand **£0 4 6**

(93) **Plane Table**, movable panel mahogany board, with **roller attachment** to take continuous length of paper, with ratchet movement, keys, etc., fitted with Casella's specially rigid tripod-head; with rule-jointed folding stand **£7 17 6**

(94) Ditto, with sliding and folding stand **£8 13 6**

SEXTANTS



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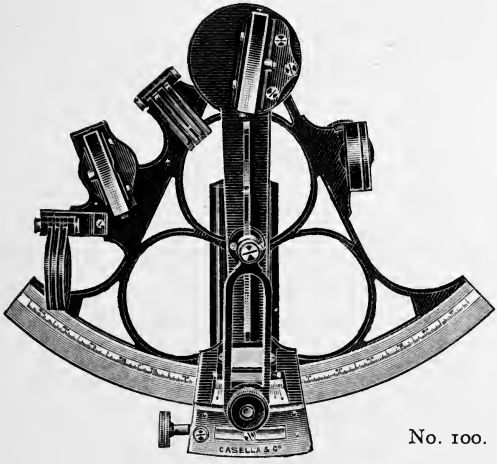

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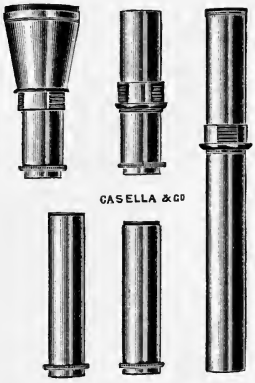
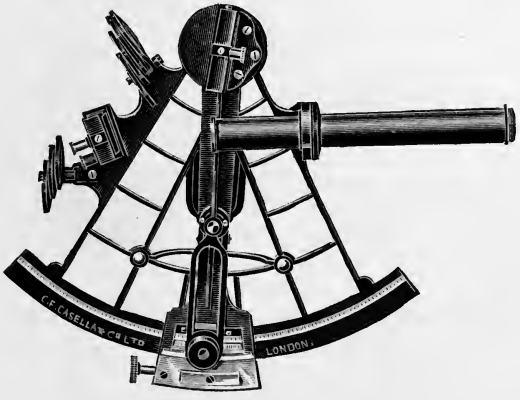




No. 97.

SEXTANTS—Continued.

(95) 8-inch **Bridge Handle Sextant**, divided on **platinum** to 10 seconds, **gold** vernier, four telescopes, seven neutral shades, swing reflector, magnifier arm and refractor, etc. In mahogany case **£20 0 0**

(96) 7-inch **Pillar Sextant**, divided on silver to 10 seconds, four telescopes, spring tangent screw, seven neutral shades, swing reflector, etc. In mahogany case **£15 10 0**

(97) 7-inch **Bridge Handle Sextant**, divided on silver to 10 seconds, four telescopes, seven neutral shades, swing reflector, etc. In mahogany case **£10 10 0**

(98) 7-inch **Straight Handle Sextant**, divided on silver to 10 seconds, four telescopes and star finder, seven neutral shades, swing reflector, etc. In mahogany case **£9 10 0**

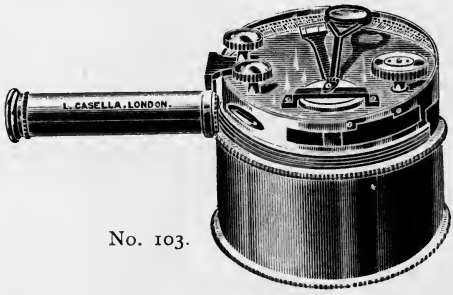
(99) 7-inch **Sextant**, flat limb, divided on silver to 10 seconds, three telescopes, seven neutral shades, swing reflector, etc. In mahogany case **£7 0 0**

(100) 6½-inch **Britannia Sextant**, improved pattern in accordance with the latest Admiralty requirements. Divided on silver to 10 seconds, two telescopes, seven neutral shades, swing reflector, etc. In mahogany case **£8 10 0**

Kew Certificate, Class A, 10s. 6d. extra.

(101) 7-inch **Sextant**, divided on **ivory** to 15 seconds, three telescopes, seven neutral shades, ground-glass reflector, fixed sight. In mahogany case **£5 17 6**

(102) 5-inch **Sounding Sextant**, for coast surveys **£6 10 0**



No. 103.

(103) 3-inch **Box Sextant**, best construction, with detachable telescope, in strong leather case **£4 15 0**

(104) Ditto, but with supplementary arc **£5 15 0**

(105) **Sextant Stand**, counterpoised, with three levelling screws, in mahogany case with lock and key **£6 6 0**

ARTIFICIAL HORIZONS

No. 106.

(106) **Casella's Mercurial Artificial Horizon.** A metal box containing mercury is covered by a glass with parallel surfaces. When not in use, a sliding valve admits the mercury into a lower compartment, so that it cannot break the glass. $3\frac{1}{2}$ in. diameter. In leather sling case **£3 15 0**

This is the most perfect portable artificial horizon made.

(107) **Artificial Horizon**, mercurial, improved, Ordnance pattern, metal roof, with parallel glasses, iron trough, highly polished iron bottle with mercury, in mahogany case, with improved packing **£4 10 0**

(108) Ditto, cheaper pattern, boxwood bottle **£3 10 0**

(109) **Artificial Horizon**, portable, Admiralty pattern, of parallel black glass, with two levels and three adjusting screws, in mahogany case, for the pocket **£2 10 0**

(110) HEPWORTH'S ELECTRIC ARTIFICIAL HORIZON

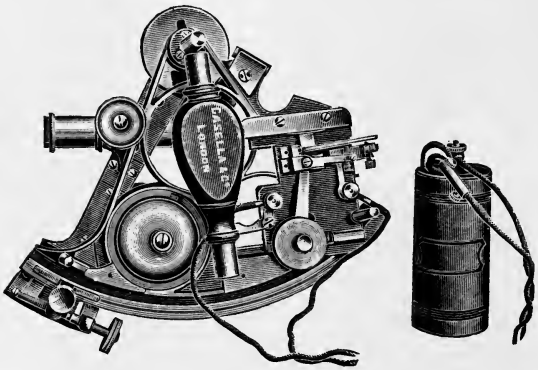
(Patent No. $9223\frac{03}{—}$).

The anxiety attending navigation, when, owing to fog, mist or other causes, the natural horizon is obscured, and reliable observations for latitude and longitude are thus rendered impracticable, although sun, moon or stars may be clearly discernible, is well known to experienced navigators.

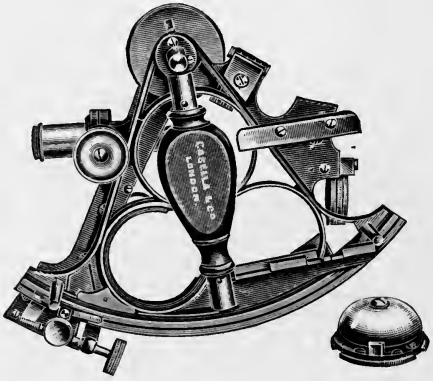
Moreover, it often happens that when the natural horizon is apparently visible, the condition of the atmosphere renders it unreliable through displacement.

HEPWORTH'S ELECTRIC ARTIFICIAL HORIZON—Continued.

Speaking generally, fog is more frequently experienced by the seaman on approaching land than at other times, and it is then that reliable observations are most needed.



An instrument invented by Commander M. W. Campbell Hepworth, C.B., R.N.R., a simple contrivance easily attached to any sextant, will enable an observer to obtain the altitude of a heavenly body under the conditions referred to, to within eight minutes of arc, or less. The instrument consists essentially of a contact maker, operated by a plummet,

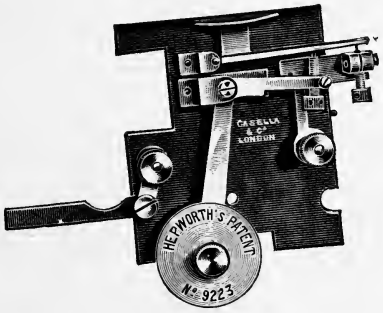


mounted on the sextant and connected with a galvanic battery. It is so adjusted as to close the circuit and ring a bell (fixed to the frame of the sextant) when a slit or line on the horizon glass is in alignment with the eye of the observer and the natural or sensible horizon.

HEPWORTH'S ELECTRIC ARTIFICIAL HORIZON— Continued.

Commander HEPWORTH'S artificial horizon is the outcome of a thoroughly sound, practical design, combined with accurate workmanship, and it has been found to be perfectly reliable, and very rapid and convenient in use.

It has been subjected to careful tests at the hands of the navigating officers of several of the principal ocean steamship lines, and has been warmly praised by all who have used it. As the illustration on the preceding page shows, this artificial horizon is contained, with the exception of the single dry cell, entirely within the frame of the sextant; it adds very little to the weight of the instrument, it is always ready for use, and it cannot get out of order.



Price.—The attachment is not expensive, but as the cost varies with the type of sextant to which it is to be fitted, we prefer to quote prices after obtaining particulars from our clients, and we therefore invite correspondence from those who are interested in the subject. The price for single artificial horizons varies from about **£6 10 0** each.

Instructions for Using the Electric Artificial Horizon

Take from the frame of the sextant the dummy pieces of wood, and in their place insert—

1. The plate carrying the mechanism, which is covered by a shield and consists of a connecting bar, contact points and plummet.
2. The bell.

HEPWORTH'S ELECTRIC ARTIFICIAL HORIZON—Continued.

The socket into which the plate fits has a spring in its upper groove which must be compressed by the upper part of the plate when it is inserted. Part of the lip of the lower groove of the socket is cut away to allow the insertion of the lower part of the plate.

The bell, when inserted, is kept in place by giving its mounting a turn to the right in the socket.

When both plate and bell have been shipped, the plate should be slid towards the bell and connected with it by means of a bar which is pivoted on the plate. The insulated wires connect the terminals on the plate with those on the galvanic battery.

The instrument being ready, the horizontal slit across the mirrored portion of the horizon glass may be used in lieu of the natural horizon. For when this slit is in alignment between the eye of the observer and the natural horizon—the sextant being held vertically—the circuit bell and battery is completed, and the bell rings. As the bell will continue to ring with the upward or downward motion of the sextant over an arc of about twenty minutes, the instrument should be so adjusted that the alignment between eye, slit and horizon coincides with the first sound of the bell on either the upward or downward movement of the sextant, whichever it may be adjusted for.

Adjustment

The instrument may be adjusted either for the sensible horizon by means of a distant object on a level with the eye of the adjuster, in which case observed altitudes will require no correction for dip, or, if the condition of the atmosphere is favourable, for the natural sea horizon, and by means of it.

To make the necessary adjustment, remove the shield protecting the mechanism from the plate by taking out the small brass screws, and raise or lower either or both of the contact points as required, until the exact adjustment is obtained :—*i.e.*, when the slit in the horizon glass is in alignment with the eye of the observer, and the natural or sensible horizon is signalled by the first ring of the bell.

If, when taking observations at sea, an observer uses, for some time, the artificial horizon simultaneously with the natural horizon, he will soon become familiar with its action, so that when the natural horizon is obscured, or unreliable, the critical moment of exact alignment will be known intuitively by the association of the senses.

CROSS HEADS

(111) **Casella's Improved Lining Cross Head**, $2\frac{5}{8}$ in. diameter, revolving compass with bar needle with adjustable heavy weight at centre; ring divided in degrees. In this pattern the compass, as well as the head proper, can be revolved, and there is a locking screw so that the former can be turned without moving the slits. The advantage of this extra adjustment is obvious. Complete in oak case 5 in. × $4\frac{1}{2}$ in. × 4 in **£1 12 6**

112) **Cross Head**, octagonal, head only ... ... from **£0 5 0**

(113) Ditto, with compass ... ... „ **£0 16 0**

(114) **Tripod Stand** for any of the above, from ... ... „ **£0 10 6**

(115) **Staff**, iron-shod, for any of the above **£0 3 6**

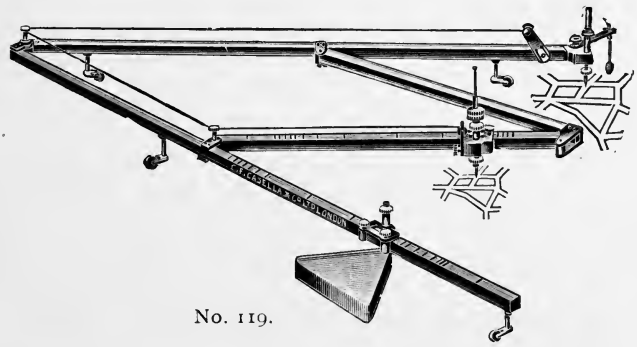
OPTICAL SQUARES

(116) **Optical Square,** in morocco case **£0 15 0**

(117) Ditto, adjusting, in solid leather case **£1 2 0**

(118) Ditto, double, in solid leather case **£2 2 0**

PANTOGRAPHS AND EIDOGRAPHS



No. 119.

(119) **Pantograph**, complete with all fittings, in mahogany case, with lock and key—

18	24	30	36	42 inch
£6 10 0	**£7 10 0**	**£8 10 0**	**£9 10 0**	**£10 10 0**

(120) **Eidograph**, complete with all fittings, in mahogany case, with lock and key, improved pattern—

30-inch	36-inch
£14 0 0	**£16 0 0**

INTEGRATORS

(121) **Amsler's Integrator**, No. 1, the simplest form **£16 0 0**

(122) **Ditto**, No. 2, large size **£24 0 0**

(123) **Ditto**, No. 3, with parallel motion **£10 0 0**

(124) **Ditto**, No. 4, the largest size, with all the latest improvements **£35 0 0**

PLANIMETERS, Etc.

No. 125.

(125) **Planimeter, Amsler's**, fixed index, reading in square inches—

Brass	Electrum
£2 2 0	**£2 5 0**

(126) **Ditto,** with sliding bar divided to various scales, English and metric—

Brass	Electrum
£2 12 6	**£2 15 0**

(127) **Ditto,** as No. 109, but with additional gauge points for taking mean height of indicator diagrams. Electrum ... **£3 5 0**

See also **The White-Bean Area Scale,** pp. 76-78.

TROCHEAMETERS

(128) **Trocheameter**, or revolution counter, for fixing to the wheel of a vehicle; in copper case with strap **£3 15 0**

(129) Ditto, with three wheels reading to 10,000 miles **£5 10 0**

PRISMATIC COMPASSES

No. 130.

(130) **Prismatic Compass,** bronzed case, engine-divided aluminium ring, with shades and mirror, in stout leather sling case.

Diameter of **ring**	2½	in.	...	...	...	...	...	...	...	£3	0	0
,,	,,	,,	2¾	,,	...	...	...	...	...	...	...	£3	3	0
,,	,,	,,	3	,,	...	...	...	...	...	...	...	£3	5	0
,,	,,	,,	3½	,,	...	...	...	...	...	...	...	£3	15	0
,,	,,	,,	4	,,	...	...	...	...	...	...	...	£4	5	0
,,	,,	,,	4½	,,	...	...	...	...	...	...	...	£5	0	0
,,	,,	,,	5	,,	...	...	...	...	...	...	...	£5	10	0
,,	,,	,,	6	,,	...	...	...	...	...	...	...	£6	15	0

(131) **Mahogany Tripod Stands**, best quality, ball and socket head, for prismatic compasses from 2½-in. to 4½-in. inclusive, each £1 10 0

(132) Ditto, for 5-in. and 6-in. prismatic compasses, each ... £1 15 0

(See also Nos. 70-73.)

(133) **Prismatic Compass**, similar to the above, but with card dial instead of aluminium ring, with shades and mirror, in stout leather sling case.

Diameter of dial,	2½	in.	...	...	...	...	...	...	...	£1	17	6
,,	,,	,,	3	,,	...	...	...	...	...	...	...	£2	2	0
,,	,,	,,	3½	,,	...	...	...	...	...	...	...	£2	7	0
,,	,,	,,	4	,,	...	...	...	...	...	...	...	£2	12	6

PRISMATIC COMPASSES—Continued.

No. 134.

(134) **Prismatic Compass,** simple form, as illustrated above, aluminium ring 2¼ inches diam.; no shades or mirror; in leather case. Price **£2 10 0**

(135) **Prismatic Compass, Service pattern**, Mark V., with sight in lid, in bronzed case, 2⅛-inch diameter; pearl dial with luminous centre, having two graduated circles, the outer one being divided to single degrees for use with the prism, and the inner one divided to five degrees and figured for ordinary compass use.

Price, in leather sling case **£3 0 0**

(See also No. 155.)

POCKET COMPASSES

No. 136.

No. 137.

No. 141.

The following compasses are all of the best quality and finish, and are fitted with stops and agate caps. Cheaper pocket compasses are also kept in stock, at prices from about **4s. 6d.** upwards.

POCKET COMPASSES—Continued.

(136) **Pocket Compass,** bronzed case, military hunter pattern, with folding sights, four cardinal points lined in red on the glass cover. Price **£2 7 6**

(137) **Pocket Compass,** watch form, 2¼-in., aluminium ring (Royal Geographical Society's pattern), agate cap, stop, etc., four cardinal points lined in red on the glass cover. In leather case **£0 17 6**

(138) **Pocket Compass,** military hunter form, in best quality **gun-metal** case.

	1¾ inch.	2 inch.
Price, with aluminium dial (R.G.S. pattern)	**£0 16 0**	**£0 18 6**

☛ *We recommend this compass in particular, as the gun-metal case can so easily be polished and made to look as good as new.*

No. 140.

(139) **Pocket Compass,** military hunter form, in best quality bronzed case.

	1¾-inch.	2-inch.
Price, with aluminium dial (R.G.S. pattern)	**£0 15 6**	**£0 17 6**
With Singer's pearl dial and luminous N-point	**£0 16 0**	**£0 18 6**
With metal dial and bar needle ...	**£0 15 0**	**£0 17 6**

(140) **Pocket Compass,** snap hunter case, similar to No. 139, but of a cheaper quality.

	1¾-inch.	2-inch.
Price, with aluminium dial (R.G.S. pattern)	**£0 13 6**	**£0 14 6**
With metal dial and bar needle ...	**£0 14 6**	**£0 15 6**

(141) **Pocket Compass,** watch form, gilt case, bar needle, graduated in degrees on raised metal ring; in maroon case. (See figure, p. 42.)

	1¾-inch.	2-inch.
Price	**£0 17 6**	**£0 19 6**

POCKET COMPASSES—Continued.

(142) **Pocket Compass,** in similar case to No. 141, but without the raised ring.

	$1\frac{3}{4}$-inch.	2-inch.
Price, with metal dial and bar needle	**£0 15 6**	**£0 16 6**
With Singer's pearl dial	**£0 16 6**	**£0 18 6**

No. 143.

(143) **Collapsible Compass,** with Singer's pearl dial, revolving in collapsible gimbals, in bright nickel or bronzed case, with morocco outer case.

	$1\frac{1}{2}$-inch.
Price	**£0 15 6**

(144) **Verner's Luminous Compass,** officer's pattern, 2-inch, in bronzed case, **aluminium luminous dial,** with clamp for direction bar, with German silver side to the case, fully divided **£1 18 6**

Leather Case for the above, with belt, loops and pocket for magnesium ribbon ... ... extra **£0 4 6**

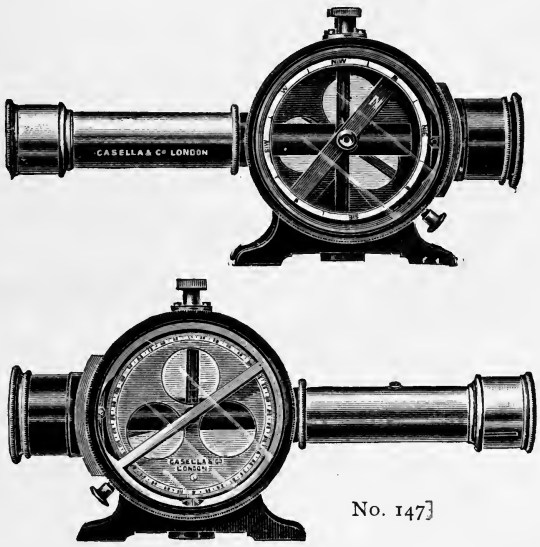
(145) **Verner's Luminous Compass,** cheaper pattern than No. 144, **card dial,** notches for sighting instead of slit in lid **£0 18 6**

Leather Case... ... ... extra **£0 4 6**

(146) **Transparent Compass,** bar needle pivoted between two quartz plates optically worked; metal ring divided into degrees and cardinal points; convenient for laying on to a map, or for use as a dip needle.

$1\frac{3}{16}$-inch.	$1\frac{1}{2}$-inch.
£1 5 0	**£1 15 0**

(147) CASELLA'S POCKET ALTAZIMUTH



No. 147]

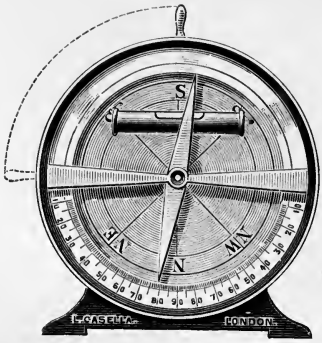
For travellers and military surveyors, improved and modified with the assistance of the late Sir Francis Galton, F.R.S.

Altitudes, azimuths, compass bearings, clinometric degrees and levels are all obtainable by means of this handy and accurate little instrument, whose diameter is $2\frac{1}{4}$-inch, thickness $1\frac{1}{8}$-inch, and weight 8-oz. Its usefulness has been much increased by the addition of an excellent telescope for distant objects, as well as by the arrangement of stops, which make it as perfect as possible for the various purposes to which the instrument is applicable. Price **£6 6 0**

Instructions for Use

The stops A or B to be turned on or off to stop or liberate the clinometer or compass ring respectively; C, the eye lens to be pushed in or out to focus the wires, as well as the divisions and figures on the inner edge of the rings. The steady-pin D to be pushed in to fix the compass before reading off. Angles on we' ground or grass may also be taken by laying down a walking stick or umbrella, resting the base of the instrument on it and fixing the circle by turning the stop, when the instrument may be raised and the angle read off from the outside rim.

No. 148.



No. 149.

(148) **Goolden's Portable Dip Circle.** This instrument is intended to meet the want of a dip circle, of moderate cost, which will not only illustrate the magnetic dip, but also be capable of some exactitude in measurement. A 3½-inch needle, provided with adjustable counterpoises ingeniously contrived so as to bring the centre of gravity very accurately into the axis of support, is carried in jewelled centres on a horizontal axis. The inclination of the needle to the horizon is read upon a metal circle, graduated on both sides, and the whole is enclosed in an air-tight box with glass faces, revolving about a vertical axis. In order to facilitate the adjustment of the needle to the magnetic meridian, the vertical axis of the instrument is furnished with a spring arm which can be clamped to it, and there are four metal studs on the stand at right angles to each other into which the head of the spring arm fits when pressed down with the finger. The stand is further provided with levelling screws, and a small level is carried in the mahogany box into which the instrument is fitted for transport.

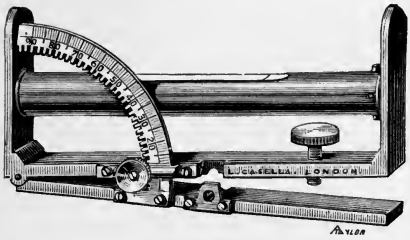
We have supplied a considerable number of these dip circles to the Indian Government, and to many public institutions in this country and abroad.

Price **£6 0 0**

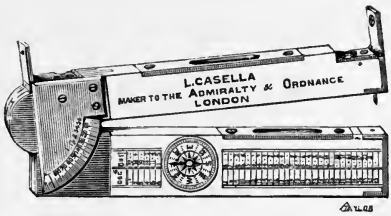
See also No. 146.

(149) **Combined Clinometer and Dip Circle,** as illustrated; this is an accurate, thoroughly reliable instrument; the needle is supported in agate bearings. Price **£3 5 0**

CLINOMETERS, ABNEY LEVELS, ETC.



No. 150



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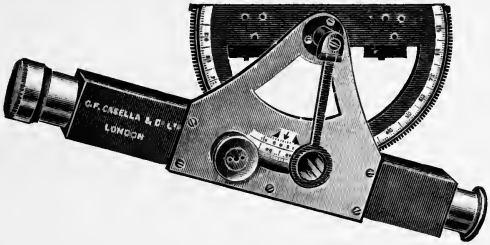
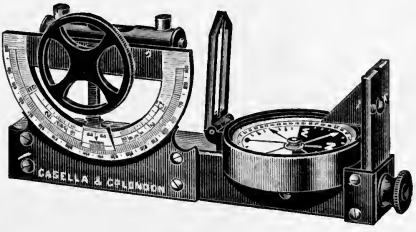


No 157.

No. 153.



No. 155.

(150) **Clinometer Level,** with sights, graduated arc, socket for stand, etc., in maroon case **£1 15 0**

(151) **Clinometer Rule,** with 2 levels, compass and sights ... **£1 10 0**

(152) **Abney Level,** in maroon case **£1 16 0**

(153) Ditto, with reader **£1 18 0**

(154) Ditto, with compass and reader **£2 2 0**

(155) Ditto, as No. 152, but with small **prismatic compass**... **£2 7 0**

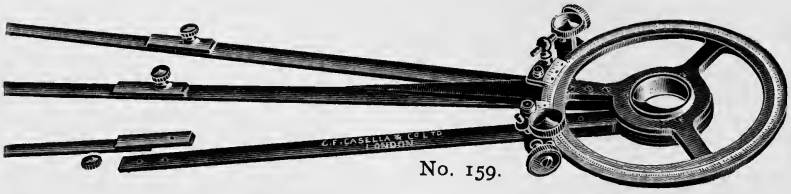
Leather cases instead of maroon for any of the above, **2s. 6d.** each extra.

(156) **Abney Level,** improved form, with large arc and long vernier reading to 10 minutes. Telescope drawing out to 7 inches. Dimensions when closed, about $3\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{8}$ in. In leather sling case... ... ... **£3 7 6**

(157) Ditto, with reader **£3 10 0**

(158) **Reflecting Sight Level,** pocket form, $4\frac{1}{4}$-inch, in case... **£0 15 6**

STATION POINTERS



No. 159.

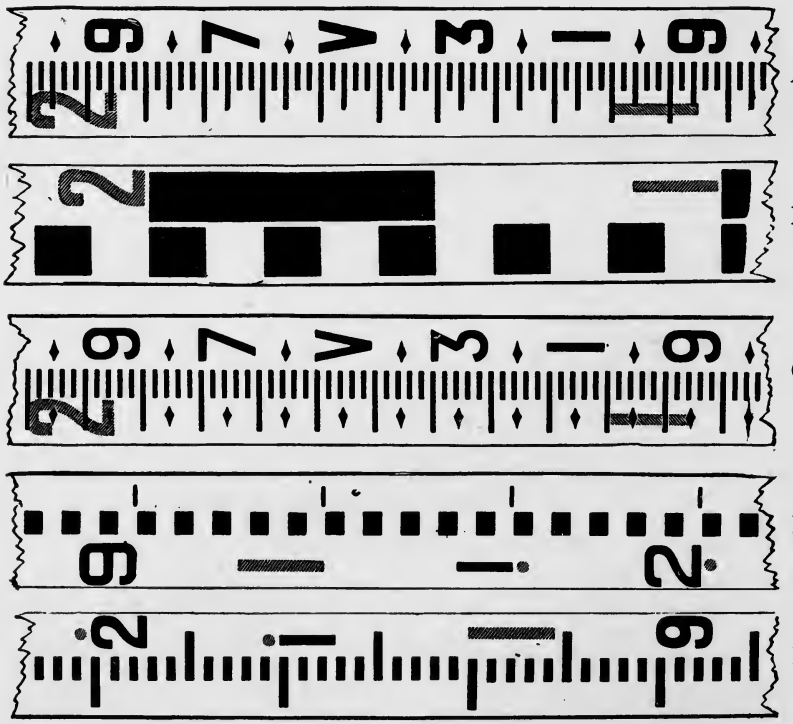
(159) **8**-inch **Station Pointer**, divided on **silver** to 1 minute, tangent screw adjustments and arms lengthening to 30-inch; in brass or gun-metal, in mahogany case ... **£13 0 0**

(160) **6**-inch Ditto, as above, but 24-inch arms **£11 0 0**

(161) **6**-inch Ditto, divided on **gun-metal** to 1 minute, tangent screw adjustments, arms lengthening to 24-inch; in mahogany case **£8 10 0**

(162) **6**-inch Ditto, as No. 161, but with 12-inch arms **£7 10 0**

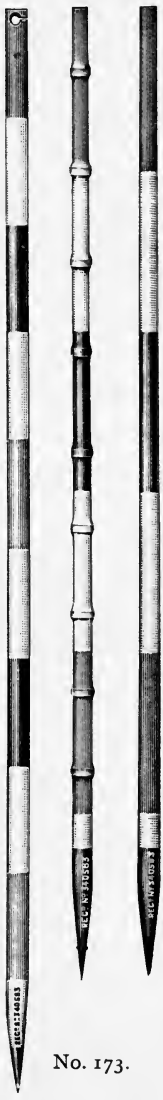
LEVELLING STAVES



No. 164.

LEVELLING STAVES—Continued.

No. 163.



No. 173.

(163) **Levelling Staff**, best quality, made of well-seasoned mahogany, brass-bound, painted figures and divisions, 14 feet or 4 metres. Pattern A, B, C, D or E **£2 5 0**

(164) Ditto, 16 feet, or 5 metres **£3 0 0**

(165) Ditto, 9 ft. 6 ins., one slide only, painted **£1 10 0**

(Reversed readings and other patterns on application.)

LEVELLING STAVES—Continued.

(166) **Flexible Levelling Staff**, of waterproof rubber cloth, with foot-plate and hand ring, 6 feet or 2 metres ... **£0 15 6**

(167) Ditto, roll-up, without plate or ring, 10 feet or 3 metres **£0 12 6**

(168) **Folding Staff** or **Stadia Rod**, mahogany, best quality, strong hinge, 2-fold—

12 feet closing to 6 feet **£2 12 6**
14 „ „ 7 feet **£3 0 0**
16 „ „ 8 feet **£3 7 6**

Metric readings extra.

Levelling staves made to special designs if required.

(169) **Levelling Staff Protector** for protecting the face of the staff when a stand is strapped to it; best quality, per pair **£0 7 6**

(170) **Spirit Level** for back of staff, circular, hinged **£0 12 6**

(171) **Staff Holder**, with handles **£0 9 6**

(172) **Triangular Metal Plate**, with chain and ring **£0 6 0**

RANGING POLES, Etc.

		Pinewood.	Bamboo.
(173)	**Ranging Poles**, in three colours, with steel shoes, 6 feet (see fig., p. 49) per dozen	**£1 12 6**	**£1 16 0**
(174)	Ditto, 8 feet ... ... „ „	**£2 5 0**	**£2 8 0**
(175)	Ditto, 10 feet ... ... „ „	**£2 18 6**	**£3 0 0**
(176)	Ditto, 2 metres, painted in decimetres, per dozen	**£1 17 6**	**£2 0 0**
(177)	Ditto, 3 metres... ... ... „ „	**£3 0 0**	**£3 5 0**
		Light Wood.	Light Bamboo.
(178)	**Ranging Poles**, as above, but **extra light**, 6 feet ... ... per dozen	**£1 10 0**	**£1 14 0**
(179)	Ditto, 8 feet ... ... „ „	**£2 3 0**	**£2 6 0**
(180)	Ditto, 10 feet ... ... „ „	**£2 16 6**	**£2 18 0**
(181)	Ditto, 2 metres ... ... „ „	**£1 15 6**	**£1 18 0**
(182)	Ditto, 3 metres ... ... „ „	**£2 18 6**	**£3 3 0**
		Brass Sockets.	Screw Joint Sockets.
(183)	**Jointed Ranging Poles**— Extra, per dozen	**£0 15 0**	**£1 17 6**
(184)	**Offset Rod**, 10 link		**£0 4 0**
(185)	Ditto, with hook and joint...		**£0 6 0**
(186)	Ditto, „ „ „ and jointed		**£0 8 0**
(187)	**Flags** for ranging poles, per dozen, from		**£0 8 6**

BONING RODS

(188) **Boning Rods**, Woolwich pattern, set of 3, one rod divided feet and inches.

3 feet ... ... **£0 12 6** 4 feet **£0 14 6**

SURVEYOR'S RODS

(189) **Surveyor's Rod**, straight—

5 feet.	6 feet.
£0 3 0	**£0 3 6**

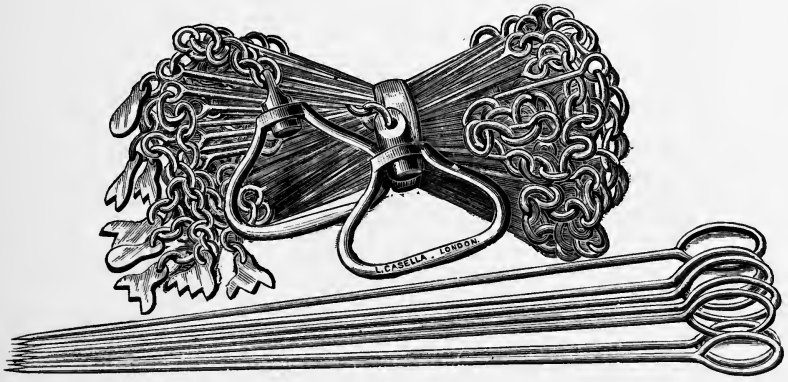
(190) Ditto, jointed, with spring catch, fully divided to $\frac{1}{8}$ inch.

5 feet.	6 feet.
£0 4 6	**£0 5 6**

(191) **Leather Case** to hold a pair of rods **£0 9 6**

(192) **Ferrule** to connect two rods **£0 2 6**

LAND CHAINS, TAPES, Etc.



(193) **Land Chain**, of best **iron** wire No. 8 S.W.G., with three oval rings, brass swivel handles, and tallies—

4 poles	50 feet	100 feet	20 metres	25 metres
7/0	**5/6**	**8/0**	**7/0**	**9/0**

Ditto, of best **steel** wire, hardened, tempered and black enamelled, with three oval rings, brass swivel handles, and tallies—

	4 poles	50 feet	100 feet	20 metres	25 metres
(194) No. 8 S.W.G.	**15/0**	**10/0**	**18/0**	**15/0**	**19/0**
(195) No. 12 S.W.G.	**12/0**	**7/6**	**14/0**	**12/0**	**15/0**

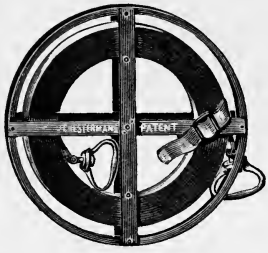
Any of the above may be had with all joints brazed, so as to form a solid chain, at an extra charge of about 66%.

LAND CHAINS, TAPES, Etc.

(196) **Land Chain Arrows**, of best steel wire, hardened, tempered and black enamelled, 15 inches long, in sets of ten—

No. 10 S.W.G.	No. 8 S.W.G.	No. 6 S.W.G.
1/3	**1/6**	**1/9** per set.

Chains in Russian and other foreign measurements quoted for on receipt of requirements.



Steel Band Chain, divided by brass studs, into **links or feet**, numbered at every ten, the first and last lengths being subdivided to tenths. Coiled on steel cross—

		2 poles	4 poles	50 feet	100 feet
(197)	½ in. wide	**8/6**	**13/6**	**9/6**	**16/0**
(198)	⅝ in. „	**10/6**	**18/0**	**13/0**	**22/0**

Ditto, divided into **5ths of a metre**, numbered every 2nd metre—

		10	20	25	30	50 metres
(199)	½ in. ...	**8/6**	**13/6**	**16/0**	**19/0**	**30/0**
(200)	⅝ in. ...	**10/6**	**18/0**	**22/0**	**25/0**	**40/0**

Ditto, bright steel, **etched feet** one side, **links** the other—

		33	50	66	100 feet
(201)	½ in. wide ...	**10/0**	**13/0**	**16/0**	**22/0**
(202)	⅝ in. „ ...	**13/0**	**18/0**	**23/0**	**32/0**

Ditto, etched **feet, inches** and **8ths** one side, **links** the other—

		33	50	66	100 feet
(203)	½ in. wide ...	**12/0**	**17/0**	**21/0**	**30/0**
(204)	⅝ in. „ ...	**14/0**	**21/0**	**26/0**	**38/0**

Ditto, etched **decimetres** both sides—

		10	15	20	25	30	50 metres
(205)	½ in. wide	**10/6**	**14/0**	**17/0**	**21/0**	**24/0**	**40/0**
(206)	⅝ in. „	**14/6**	**19/0**	**24/0**	**30/0**	**36/0**	**57/0**

LAND CHAINS, TAPES, Etc.

Steel Band Chain, bright steel, etched **millimetres** both sides—

		10	15	20	25	30	50 metres
(207)	½ in. wide	**14/6**	**20/0**	**25/0**	**30/0**	**36/0**	**65/0**
(208)	⅝ in. ,,	**17/6**	**25/0**	**32/0**	**39/0**	**46/0**	**75/0**

Ditto, etched **feet** one side, **decimetres** the other—

		33	50	66	100 feet
		10	15	20	30 metres
(209)	½ in. wide ...	**10/6**	**14/0**	**17/0**	**24/0**
(210)	⅝ in. ,, ...	**13/6**	**19/0**	**24/0**	**36/0**

Steel Band Chain, etched **feet, inches** and **8ths** one side, **millimetres** the other—

		33	50	66	100 feet
		10	15	20	30 metres
(211)	½ in. wide ...	**14/6**	**20/0**	**25/0**	**36/0**
(212)	⅝ in. ,, ...	**17/6**	**25/0**	**32/0**	**46/0**

(213) **Metal case** in place of steel cross for any of the above steel band chains—

For ½ in. widths **4/0** ⅝ in. widths **6/0** extra

(214) **Steel Tape Measures,** standardized at 62° F., ¼ in. wide for pocket, marked on **one side only,** in leather cases, with flush handles—

33 ft.	50 ft.	66 ft.	20 metres
10/6	**13/6**	**17/0**	**17/0**

Steel Tape Measures, marked on **one side,** in leather cases, with flush handles—

		33 ft.	50 ft.	66 ft.	100 ft.	20 metres	25 metres
(215)	⅜ in.	**13/0**	**17/6**	**22/0**	**31/0**	**22/0**	**27/0**
(216)	½ in.	**15/6**	**21/0**	**27/0**	**38/0**	**27/0**	**33/0**
(217)	¾ in., extra strong	**19/0**	**27/0**	**35/0**	**49/0**	**35/0**	**42/0**

(218) **Linen Tape Measures, "Constantia" Make,** marked on both sides —

The following prices include cases with **flush handles,** as these are more compact than **folding handles.** The latter are, however, easier to wind up and will be supplied when desired. They are slightly cheaper than the flush handles.

	33 ft.	50 ft.	66 ft.	100 ft.	20 metres	25 metres
⅝ in.	**5/9**	**7/0**	**8/3**	**11/6**	**8/3**	**9/8**

(219) **Metallic Linen Tapes,** marked on both sides, in leather cases, with flush handles, ⅝ in. wide, same lengths and prices as No. 218.

WOVEN AND STEEL TAPES

Complaints are occasionally made of the inaccuracy of woven tapes; this usually arises from the fact that too much is expected of this kind of tape. For **precise** and **accurate** measurements a woven tape is unsuitable, a **steel** tape should be employed. For less important work a woven tape is often very convenient.

Of the woven tapes listed above the "Constantia" are the most accurate and durable.

All woven tapes should be tested periodically with a steel tape, and in cases where accuracy is required and measurement by a steel tape is impracticable the woven tape should be carefully tested both before and after use and an allowance made for errors. For this purpose a short, inexpensive steel tape may be used.

TAPE THERMOMETERS

(220) **Tape Thermometer,** 8 inch tube, divided on the stem, on steel mount, arranged to clip on to the tape, the whole fitting into a polished boxwood case; Fahrenheit or centigrade. Price, complete **£1 1 0**

(221) Ditto, 4 inch tube, divided on the stem, on boxwood mount, with steel clips; Fahrenheit or centigrade. Price **£0 12 6**

PEDOMETERS, PERAMBULATORS, Etc.

(222) **Pedometer,** watch-form, with automatic setter, nickel case, reading to 100 miles... ... ... **£1 0 0**

(223) Ditto, silver case **£1 5 0**

(224) Ditto, but combined with compass and map measurer... **£1 5 0**

(225) **Passometer,** reading to 10,000 paces, in nickel case ... **£1 5 0**

(226) **Perambulator,** reading up to 20,200 yards without re-setting **£5 15 0**

(227) Ditto, better quality, 2 yards circumference, registering miles, furlongs and yards... ... ... **£9 0 0**

(227A) Ditto, ditto, as No. 227, but metric **£10 0 0**

TELESCOPES

Tourist or Deer-Stalking Telescope, 3 draws, pancratic eyepiece, brass mounts, body covered with black or brown leather, with strong leather case and shoulder straps.

	Diam. of Object Glass.	Magnification.	
(228)	1¾ inch	20 to 25 diam.	£4 15 0
(229)	2 „	25 to 35 „	5 10 0
(230)	2¼ „	25 to 35 „	6 0 0
(231)	2½ „	30 to 40 „	9 0 0

Ditto, but with German silver mounts and covered with Russia leather. This telescope is made of a very light metal, superseding aluminium.

	Diam. of Object Glass.	
(232)	1¾ inch	£6 5 0
(233)	2 „	7 10 0
(234)	2¼ „	9 0 0
(235)	2½ „	12 10 0

A table stand of bronzed brass, with vertical and horizontal movements, and a **mahogany case** can be supplied for the above telescopes, from **£3 10 0** (the two).

MARINE TELESCOPES

Officer of the Watch Telescope, in German silver, covered with brown leather.

	Diam. of Object Glass.	Magnification.	
(236)	1¼ inch	16 diam.	£2 5 0

Officer's Telescope, Admiralty Pattern, straight body, made in the special light alloy, covered with pigskin, with **pancratic eyepiece.**

	Diam. of Object Glass.	Magnification.	
(237)	1¾ inch	15 to 20 diam.	£5 5 0
(238)	2¼ „	25 to 35 „	6 10 0

Larger sizes to order.

MARINE TELESCOPES—Continued.

Navy Telescope, also used in artillery practice; straight body, 1 draw, bronzed brass mounts, body covered with pigskin.

	Diam. of Object Glass.	Magnification.	
(239)	1⅝ inch	16 diam.	£2 5 0
(240)	1¾ „	18 „	2 15 0
(241)	2 „	24 „	3 10 0
(242)	2¼ „	28 „	4 10 0

No. 243.

Coastguard Telescope, taper body, nickel-plated mounts, 2 caps and sling strap.

	Diam. of Object Glass.	Magnification.	
(243)	2⅛ inch	28 diam.	£3 10 0

MILITARY TELESCOPES

Army Telescope, in brass, covered with brown leather, 2 eyepieces, with caps and strap and a pocket for the second eyepiece, 3 draws.

	Diam. of Object Glass.	Magnification.	
(244)	2 inch	15×20 diam.	£4 0 0

Army Signal Station Telescope, in brass, covered with brown leather, rack focussing, table or garden stand; in varnished pine case.

	Diam. of Object Glass.	Magnification.	With Garden Stand.	With Table Stand.
(245)	2½ inch	34 diam.	£13 10 0 ...	£12 10 0
(246)	3 „	42 „	18 15 0 ...	17 15 0
(247)	3½ „	50 „	31 0 0 ...	29 0 0

ASTRONOMICAL TELESCOPES

Nos. 248-252.

Nos. 248-252.

ASTRONOMICAL TELESCOPES—Continued.

"Educational" Astronomical and Look-out Telescope, with **second quality object glass,** bright brass body, bronzed brass cradle fittings, rack and sliding focussing adjustments, one astronomical eyepiece, and one terrestrial; in varnished white wood case.

	Diam. of Object Glass.	Length.	With Garden Stand.	With Iron Table Stand
(248)	2¼ inch	30 inch	£6 15 0	£4 17 6
(249)	2½ „	26 „	7 7 0	5 10 0
(250)	3 „	42 „	8 10 0	6 10 0
(251)	3¼ „	42 „	11 0 0	9 0 0
(252)	3½ „	48 „	14 0 0	11 10 0

This last telescope has two astronomical eyepieces.

ASTRONOMICAL TELESCOPES—Continued.

Nos. 253-257.

Middle Quality Astronomical Telescope, with **second quality object glass;** all bright brass, rack and sliding focussing adjustments; with racked steady rod; one astronomical eyepiece and one terrestrial; in polished mahogany case, with lock and key.

	Diam. of Object Glass.	Length.	With Garden Stand.	With Table Stand.
(253)	2¼ inch	30 inch	£11 17 6 ...	£10 0 0
(254)	2½ „	36 „	13 2 6 ...	11 5 0
(255)	3 „	42 „	15 0 0 ...	13 0 0
(256)	3¼ „	42 „	17 10 0 ...	15 10 0
(257)	3½ „	48 „	23 10 0 ...	21 0 0

This last telescope has two astronomical eyepieces.

(258) **Star Finders** supplied with middle quality astronomical telescopes at the following prices:

For 2½, 3 and 3¼ inch ... ...each **£1 17 6**
For 3½ inch ... ... „ **£2 12 6**

ASTRONOMICAL TELESCOPES—Continued.

Nos. 259-263.

ASTRONOMICAL TELESCOPES—Continued.

(259) **Best Quality Astronomical Telescope,** with **best quality object glass;** all bright brass specially well finished; rack and sliding focussing adjustments; rack and clamp to steady rod; one astronomical eyepiece (70 diams.) and one terrestrial (30 diams.); in polished mahogany case with lock and key—

Diam. of Object Glass.	Length.	With Garden Stand.	With Table Stand.
2¼ inch (clear aperture)	30 inch	£12 10 0	£12 0 0

(260) **2½ inch Ditto,** but with two astronomical eyepieces (80 and 120), pancratic terrestrial eyepiece (35).

Diam. of Object Glass.	Length.	With Garden Stand.	With Table Stand.
2½ inch (clear aperture)	36 inch	£18 5 0	£17 15 0

(261) **3 inch Ditto,** but with three astronomical eyepieces (100, 150 and 200), pancratic terrestrial eyepiece (45), and with star finder.

Diam. of Object Glass.	Length.	With Garden Stand.	With Table Stand.
3 inch (clear aperture)	42 inch	£25 10 0	£25 0 0

(262) **3¼ inch Ditto** ... ... £30 0 0 ... £29 0 0

(263) **3½ inch Ditto,** but astronomical eyepieces of powers 150, 200 and 300, and pancratic terrestrial eyepiece of power 50 £49 0 0 ... £45 0 0

(264) **A Tangent Screw Attachment** can be fitted to any of these best quality astronomical telescopes for producing a slow motion in azimuth. The endless screw is rotated during observation by means of a Hook's joint handle. The price of this fitting for a 2½ or 3 inch telescope is **£3 0 0**; for other sizes the price will be quoted on application.

ASTRONOMICAL TELESCOPES—Continued.

Nos. 265-266.

Best Quality Altazimuth Telescope with **best quality object glass,** all the workmanship and finish being of the same high quality as in the telescopes last described. In addition it is fitted with coarse and fine altitude adjustments (as shown in the figure). The stand is extremely rigid, but compact when folded together for travelling. The prices include a polished mahogany case with lock and key and all the usual accessories—

	Diam. of Object Glass.		
(265)	3 inch	... ...	**£25 10 0**
(266)	3½ „	... ...	**40 0 0**

ASTRONOMICAL TELESCOPES—Continued.

Slow Motion in Azimuth ... ... extra **£3 0 0**

Quotations for other sizes up to 5 inch aperture on application.

(267) **Astronomical Telescope for travellers and explorers,** very compact, brass body to unscrew in the middle for packing, with two astronomical and one terrestrial eye-piece; packed in mahogany case. Object glass, $2\frac{1}{4}$ inch **£13 0 0**

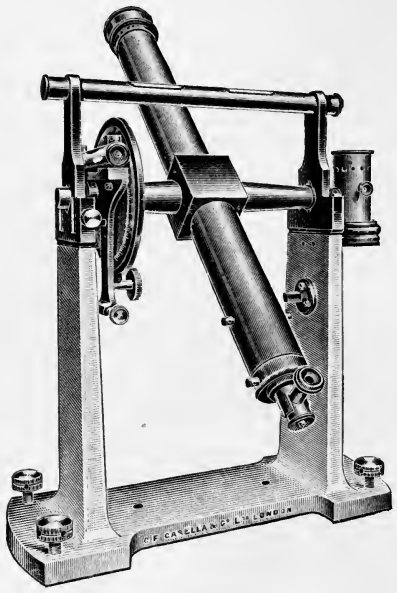
Extras for Telescope No. 267.

Diagonal Eyepiece	**£1 10 0**
Adapter for Screwing Telescope to a Tree	**0 15 0**
Mahogany Stand	**3 7 6**

EQUATORIAL TELESCOPES, CLOCKS, ETC.

Particulars of these will be sent on application.

TRANSIT INSTRUMENT



No. 268.

(268) **Transit Instrument,** with reversible telescope, object glass, 1 inch aperture and 12 inches focal length; diagonal eyepiece with 1 horizontal and 5 vertical lines, 4 inch circle divided on brass and reading by vernier to 1 minute; spirit level on vernier arm, stride level, perforated axis, lamp, etc. On cast-iron stand with levelling screws and azimuth adjustments. Complete in pine case, as figured **£14 14 0**

(269) **Ditto,** with object glass, 1¾ inch aperture and 18 inches focal length **£18 18 0**

Estimates for larger sizes on application.

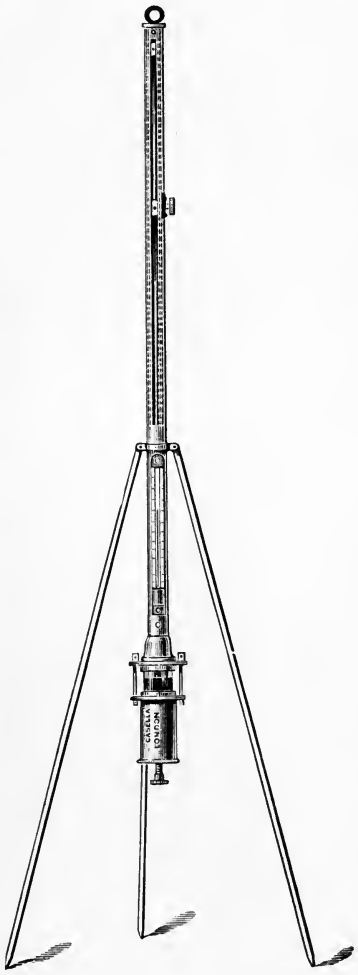
TELESCOPE STANDS

(270) **Garden Stand,** mahogany, brass fittings, very strong and rigid.

For Telescope	2¼	2½	3	3¼	3½ inch.
	£3 10 0	**£3 15 0**	**£4 5 0**	**£4 10 0**	**£5 0 0**

MERCURY BAROMETERS

(271) **Standard Mountain Barometer.** Although, in essentials this **mountain barometer** is precisely the same as a standard Fortin barometer, it has been much reduced in size of frame so as to render it extremely portable and to remove nearly every difficulty found by travellers in carrying a mercury barometer. It can be fitted either with the tripod shown in the figure or with a longer tripod, enabling the barometer to be suspended from the ring at the top, though we usually supply the shorter one for the sake of greater portability. The longer legs provide a more stable position for the barometer, but have the drawback that they cannot be packed on the leather case in such a convenient manner as the shorter stand, and we think travellers will find the increased portability of the shorter pattern a sufficient compensation for the less stable method of suspending the instrument.



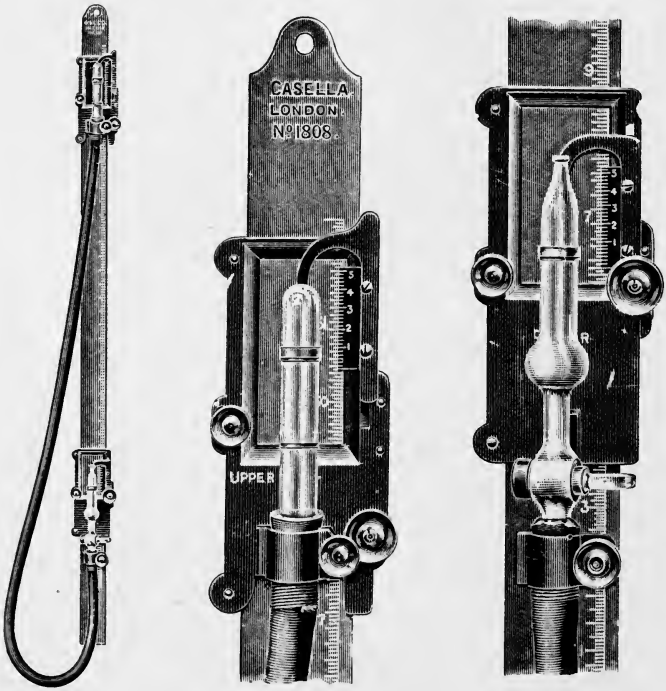
No. 271.

Price, with inch and millimetre scales, graduated down to 15 inches and 385 mm. (equal to about 18,000 feet); with attached thermometer and tripod stand; in improved leather-covered shield-case with shoulder-strap, complete **£10 10 0**

Kew Verification, extra 15s. 6d. If without case, 25s. less.

MERCURY BAROMETERS—Continued.

(272) **Collie's Barometer**, an interesting form of portable mercury barometer, in which the tube, being made of specially prepared, non-porous, rubber tubing, is quite flexible and can be coiled up when not in use. The illustration below shows the general construction and the details of the more important parts. To each end of the rubber tubing is fixed a glass tube and these tubes are made to fit into receiving sockets on two carriages, which can be clamped at any position on the graduated aluminium bar. The glass tube fitted to the lower end of the rubber tubing (and corresponding to the cistern of an ordinary barometer) is provided with a carefully



No. 272.

ground stopcock, which is left open when a reading is being made and closed when the instrument is not in use. The carriages are each fitted with a clamp, tangent screw and vernier for accurate reading as in a standard barometer. The aluminium scale fits into a mahogany case, and the barometer tube together with the two carriages and a few accessories is packed in another box measuring about 10 in. × 10 in. × 4 in., the whole forming a most efficient portable barometer for travellers and explorers.

Price **£20 0 0**

MERCURY BAROMETERS—Continued.

(273) **Mountain Barometer, Gay-Lussac's** siphon tube, with vernier to each limb, reading to 0·002 inch, the difference between the two readings giving the height of the barometer. In improved leather-covered shield case.

Price **£6 10 0**
If with tripod stand **£8 0 0**

(274) **Boylean Mariotti Barometer or Standard Mercurial Pocket Barometer**—

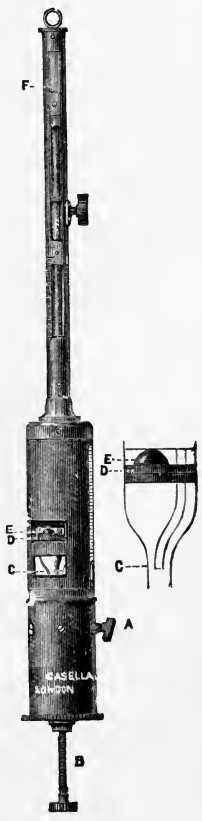
This pocket barometer, whose action depends on the laws of Mariotti and Boyle, consists of a short centre glass tube, a lower open air tube, or bulb, with diaphragm joined to it, with a vulcanite covering for insulation, and a brass tube, or shield, which covers the glass tube, and on which the graduations and figures are engraved. Attached to this is a cistern filled with mercury, which has a stopcock and a coarse screw adjustment.

The total length of the Mariotti barometer is from 12 to 15 inches; but, for convenience of carriage, the cistern may be detached at pleasure and carried separately.

The weight and pressure of the atmosphere is determined accurately, at each observation, by an uniform volume of air being admitted to the cistern, and compressed by the advance of the mercury to a fixed point, or zero, so that no accumulation of error is possible; and the reading will be equally accurate for all times and for all places.

It is not necessary that the same quantity of mercury be always used, so that the loss of a little is of no moment; and it need not be boiled.

The readings are taken from two points as in Fortin's barometer, and the scale is read to hundredths of an inch by means of a vernier.



No. 274.

This instrument is equally accurate at the bottom of a mine and at the top of a mountain, but it is in the fact that this really portable barometer needs no adjustment that its great merit lies; hence its value to travellers and residents in foreign countries, where a mercurial standard cannot easily be referred to. **Price**, in case **£10 10 0**

MERCURY BAROMETERS—Continued.

Instructions for Using the Boylean Mariotti Barometer

(1) It is very important that the barometer shall be strictly vertical while readings are being taken. If possible it should be suspended from a fixed hook rather than held in the hand.

(2) Turn the brass stopcock (projecting from the cistern) into a vertical position. This connects the tube with the cistern.

(3) Carefully screw up the brass screw below the cistern until the mercury, rising in the closed tube in the lower part of the instrument, just cuts off the light passing through the slot at the top of the opening in the lower part of the barometer.

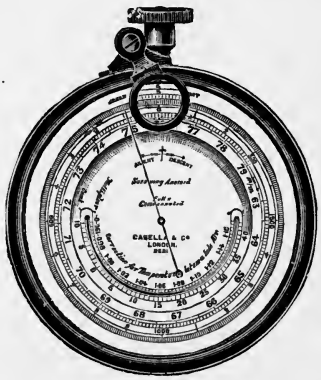
(4) *Immediately* read the height of the mercury column at the top of the instrument by the help of the vernier, one division of which = ·01 inch.

It is important that this should be done *as soon as possible* after screwing up the mercury.

(5) Release the stopcock and lower the mercury into the cistern after each observation.

In the case of the Mariotti barometer, unlike ordinary mercury barometers, the instrument is not always in action. The tube must be emptied after each observation and only re-filled shortly before a reading is required.

ANEROID BAROMETERS FOR SURVEYING AND MINING PURPOSES



No. 275.

(275) **Mining and Surveying Aneroid**, 5 in., with scale of **ascent** to 4,000 feet, and **descent** to 2,000 feet, subdivided to 10 feet, and reading by means of a vernier and lens to 1 foot. In strong leather sling case complete. Price **£9 0 0**

(276) Ditto, to 10,000 feet subdivided to 2 feet **£9 10 0**

(277) Ditto, to 15,000 feet subdivided to 5 feet **£10 0 0**

(278) Ditto, to 20,000 feet subdivided to 5 feet **£10 15 0**

ANEROID BAROMETERS FOR SURVEYING AND MINING PURPOSES—Continued.

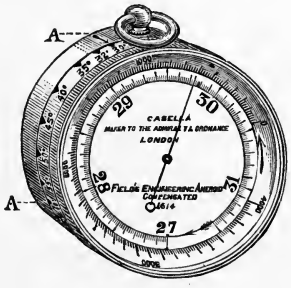
(279) Ditto, 5 in., without vernier, scale of ascent to 7,000 feet and descent to 2,000 feet. In strong leather sling case **£6 0 0**

(280) Ditto, 3 in., without vernier, altitude scale on raised dial, with lens. In strong leather sling case... ... ... **£5 0 0**

Kew Certificate for any of the above ... ... from **£0 10 6**

(281) **Field's Engineering Aneroid**—

One of the chief uses of aneroid barometers is for measuring differences of elevation by means of the diminution which takes place in the atmospheric pressure as one ascends. This diminution is not equal for equal differences of altitude, in consequence of the elasticity of the air, which allows the lower strata to be pressed more closely together than those above them; but it follows known laws, and hence altitude scales have been computed, taking into account the varying ratio between pressure and altitude.



No. 281.

There is, however, a second cause of variation, which (though included in the recognized formulæ for reducing barometrical determinations of altitude) has not been included in any altitude scale yet published. This cause is the variable temperature of the air,* which will evidently affect the result by affecting the density of the air, and therefore the ratio of pressure to altitude. In the engineering aneroid invented by Mr. Rogers Field, B.A., Assoc. Inst. C.E., this variation is for the first time taken into account by the scale being made adjustable for temperature. The principle of adjustment is that of shifting the altitude scale according to the temperature of the air. There is nothing novel in movable scales of themselves, as they are frequently used with aneroids for the purpose of shifting the zero of

* This must not be confounded with the changes produced by alterations in the temperature of the instrument itself, which may be neglected, as the compensation for temperature is as nearly perfect as possible.

ANEROID BAROMETERS FOR SURVEYING AND MINING PURPOSES—Continued.

the scale to correspond with the varying position of the hand. This method of using them is, however, radically wrong, as the shifting of the scale makes it inaccurate, and the novelty consists in taking advantage of this inaccuracy to obtain a valuable means of adjustment. The scale that is inaccurate for one temperature is practically accurate for another, so that we have only to shift the scale into certain different fixed positions to obtain a series of different scales suitable for different temperatures of the air.

The altitude scale adopted in this aneroid is that of the Astronomer Royal (which has been compared with the formulæ of Laplace, Guyot, Baily, Plantamour and other authorities, and found to give results lying between them), and as the instrument is intended for the accurate measurement of moderate altitudes, the range is purposely limited so as to give an open graduation. The adjustment for the temperature of the air is applied by shifting the scale in accordance with the figures engraved on the outside of the instrument, marked A A on wood-cut. The rim which holds the glass should be slightly raised, so as to be free from the locking-pin, and then turned until the figures corresponding to the air temperature are opposite to the pin, when the glass should be depressed so as to re-lock it.

The process of observation is extremely simple. The first thing is to determine, either by observation or estimation, the air temperature likely to prevail during the series of observations; if this is done within 5° F. it will be sufficiently accurate (within about 1 per cent.). The scale must then be set to this temperature in the manner above explained. Subsequently the readings must be taken from the outer scale of feet, and the *difference* will give the difference of elevation. The following example of actual observations taken between Hampstead and London will explain the proceeding :—

Temperature of air 40° F. *and scale set accordingly.*

	Feet.
Journey to London :—	
Reading at Jack Straw's Castle, Hampstead	1640
„ „ Horse Guards, London	1200
Difference	—440
Journey from London :—	
Reading at Horse Guards, London	1215
„ „ Jack Straw's Castle, Hampstead	1640
Difference	—425
	2)865
	432 Feet.

ANEROID BAROMETERS FOR SURVEYING AND MINING PURPOSES—Continued.

The true difference of altitude, according to the Ordnance Levels, is 428 feet, showing an error of only 4 feet. The accuracy of the result will be further increased if the observations are repeated more than once, and the average of the results taken.

*** It should be mentioned that the above principle of adjustment can only be correctly applied to aneroids in which the graduation is nearly uniform, and therefore extreme care is taken in the selection of suitable instruments for this purpose.

Price, in case complete **£6 6 0**

ANEROID BAROMETERS

Watch Size, for the Waistcoat Pocket, $1\frac{7}{8}$ in. diameter.
In Gilt Cases, with Silvered Dials.

The following prices include velvet-lined maroon cases and apply equally to aneroids with English or with metric graduations.

These instruments are usually constructed with fixed altitude scales with the zero at 30 in., but this can be put at 31 in. if desired.

(282) **Aneroid Barometer,** $1\frac{7}{8}$ in., engine-divided silvered dial giving barometric heights from 28 in. to 31 in., no altitude scale; with weather terms... ... ... **£2 2 0**

(283) **Aneroid Barometer,** $1\frac{7}{8}$ in., **best quality** movement, compensated for changes of temperature, with altitude scale giving about 1,000 ft. **descent** and 9,000 or 11,000 ft. **ascent** **£4 0 0**

(284) Ditto, 14,000 ft.* **ascent**... ... ... **£4 10 0**

(285) Ditto, 17,000 or 19,000 ft.* **ascent** **£5 0 0**

* Where a long range is required it is preferable to have the pocket-size aneroid, $2\frac{3}{4}$ in., as a more open scale is obtained with these than with the watch size. Watch aneroids are chiefly intended for ranges of about 5,000 or 7,000 feet.

ANEROID BAROMETERS—Continued.

(286) **Aneroid Barometer**, $1\frac{7}{8}$ in., best quality movement, compensated, with **expanded graduations;** reading to one-fiftieth in.; with fixed altitude scale to 2,000 ft. ... **£4 15 0**

The sensitiveness of this instrument is very remarkable.

(See also Nos. 292, 298.)

Kew Verifications for any of the above, 10s. 6d. each.

Extra Fittings for Watch Aneroids

The aneroids mentioned above may be fitted with the following accessories at the prices named.

(a) **Revolving, instead of Fixed Altitude Scale,** by means of which the zero can be set opposite to the pointer. It is not quite so accurate as a fixed scale, but is convenient for certain purposes. For this we make no extra charge.

(b) **Curved Thermometer**, on the dial, with raised circle for the barometric scale ... ... extra **£0 10 0**

(c) **Curved Thermometer,** fitted to the back of the aneroid extra **£0 10 0**

(d) **Small Compass,** pearl, bar, or luminous pattern, fitted to the back ... ... extra **£1 0 0**

(e) **Full Sized Compass,** to screw on to the back, pearl, bar or luminous pattern ... ... extra **£1 10 0**

(f) **Silver Case,** instead of gilt ... ... extra from **£1 0 0**

(g) **18-Carat Gold Case**, instead of gilt ... ... extra from **£7 10 0**

(h) **Sling Leather Case,** instead of maroon ... ... extra **£0 3 6**

ANEROID BAROMETERS

Pocket Size, $2\frac{3}{4}$-inch diameter.

Gilt, in Velvet-Lined Maroon Cases, English or Metric Scales.

(287) **Aneroid Barometer**, $2\frac{3}{4}$ inch, engine-divided, silvered dial, giving barometric heights from 28-inch to 31-inch; with weather terms, no altitude scale **£2 10 0**

ANEROID BAROMETERS—Continued.

(288) **Aneroid Barometer,** $2\frac{3}{4}$ inch, best quality movement, compensated for changes of temperature, with fixed altitude scale reading to any height up to about 10,000 feet **£4 10 0**

(289) Ditto, to about 15,000 feet **£5 0 0**

(290) Ditto, to about 20,000 feet **£5 10 0**

(291) Ditto, from about 8,000 to 18,000 feet **£5 5 0**

(292) **Aneroid Barometer,** $2\frac{3}{4}$ inch, best quality movement, compensated, with **expanded graduations,** and reading to one-fiftieth inch, with fixed altitude scale to 2,000 feet. This instrument is similar to No. 286, being of the same highly sensitive construction. (See also Nos. 286, 298) **£5 10 0**

Kew Verification for any of the above according to the number of readings taken ... ... from **£0 10 6**

Extra Fittings for Pocket Aneroids

(a) **Revolving, instead of Fixed, Altitude Scale,** no extra charge.

(b) **Curved Thermometer,** on the dial, with raised circle for the barometric scale ... ... extra **£0 10 0**

(c) **Curved Thermometer,** Centigrade and Fahrenheit, fitted to the back of the aneroid... ... ... extra **£1 5 0**

(e) **Small Compass,** pearl, bar or luminous pattern, fitted to the back ... ... extra **£1 10 0**

(f) **Full Sized Compass** to screw on to the back, pearl, bar or luminous pattern ... ... extra **£2 0 0**

(g) **Silver Case,** instead of gilt ... ... extra **£1 10 0**

(h) **Sling Leather Case,** instead of maroon ... ... extra **£0 3 6**

(i) **Carved Oak, Walnut or other Stand,** ... extra, from **£0 10 0**

ANEROID BAROMETERS

Full Size, $4\frac{1}{2}$ inch diameter.

No. 297.

The following prices do **not** *include* **cases,** *which will be found among the "extra fittings."*

(293) **Aneroid Barometer,** $4\frac{1}{2}$-inch card dial, with printed graduations, from 28 inch to 31 inch, and weather terms **£1 0 0**

(294) Ditto, better quality, engine-divided metal dial **£2 0 0**

(295) **Aneroid Barometer,** open engraved metal dial, to show the interior mechanism **£3 0 0**

(296) **Aneroid Barometer,** $4\frac{1}{2}$ inch best quality movement, compensated, barometric scale only, as used in the Navy **£4 2 6**

(297) **Aneroid Barometer,** $4\frac{1}{2}$ inch, best quality movement, compensated, with fixed altitude scale to about 10,000 feet **£4 15 0**

Ditto, 0 to 15,000 feet **£5 5 0**

Ditto, about 0 to 20,000 feet **£5 15 0**

(298) **Aneroid Barometer,** superior, extra sensitive, with greatly **expanded graduations,** divided to one-hundredth of an inch, each barometric inch being equal to nearly four inches, with circular thermometer and engraved ornamental dial (see Nos. 286, 292) ... **£5 5 0**

Extras for $4\frac{1}{2}$-inch Aneroids

(a) **Hinged Morocco Case,** velvet-lined... ... ... extra **£0 5 6**

(b) **Best Quality Leather Sling Case,** with bulged side for protection **£0 10 0**

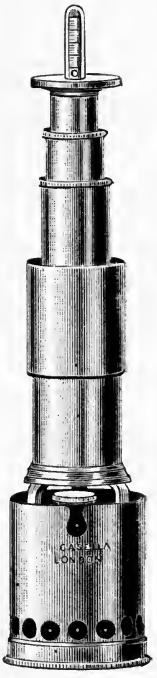
(c) **Revolving, instead of Fixed, Altitude Scale** extra **£0 12 6**

(d) **Curved Thermometer,** on dial, Centigrade and Fahrenheit... ... ... extra **£0 12 6**

HYPSOMETERS

The principle of the hypsometer is based on the lowering of the boiling-point of water under diminished atmospheric pressure. When the instrument is correctly constructed and furnished with a really accurate thermometer it may be made an efficient and handy means of measuring heights in surveying or botanical geography, and it is at all times a reliable test with which to compare an aneroid barometer or similar instrument requiring from time to time to be verified and adjusted.

Though not, of course, so accurate as a standard barometer, it removes that great drawback to the unrestrained motion of the traveller—the transport of a glass tube, 3 feet long, filled with mercury and encased in metal.



No. 299.

(299) **Hypsometer, full size;** improved form. As figure 299 indicates, this apparatus consists of a vessel for boiling water, with a double-walled, telescopic tube in which the thermometer is suspended. The steam from the boiling water fills the inner chamber, and thence passes down the steam jacket into the outlet tube at the bottom, where it escapes into the air. In this way the bulb and the stem of the thermometer are immersed in the vapour. Less than a wine-glassful of water and half that quantity of methylated spirit serve for several determinations.

The instrument packs into a sling leather case 12½ in. × 4 in., and the thermometer, when not in use, is kept in a rubber-lined brass tube, for which there is a socket in the case.

Price, in sling leather case, with one thermometer, Fahr. or Cent., divided to 0°·1, and with table of heights ... **£4 15 0**

Extra Thermometers, in rubber-lined cases, each ... **£1 5 0**

Self-Registering Thermometers for the above, with maximum indices (on Phillips's principle) ... ...each **£1 5 0**

Kew Verification for the thermometer **£0 3 6**

Sling Leather Case, separate **£0 17 6**

HYPSOMETERS—Continued.

(300) **Hypsometer, pocket size;** a smaller instrument, constructed on the same plan as the preceding one, designed for Alpine travellers and others who desire extreme portability. This pattern can be carried in the pocket with ease. In sling leather case, with thermometer reading to $0^{\circ}{\cdot}2$, as supplied to the Royal Geographical Society, etc. **£3 3 0**

Extra Thermometers, in rubber-lined brass tubes, each **£1 1 0**

Self-Registering ditto ... ... ,, **£1 5 0**

Kew Verification for each thermometer... ... ... **£0 3 6**

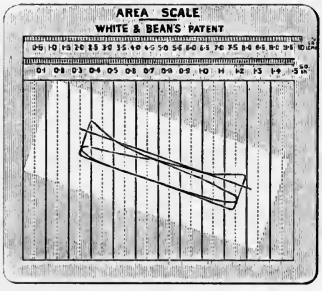
Sling Leather Case, separate **£0 12 6**

(301) **Casella's Hypsometer Tables,** with instructions for using the instrument, second edition **£0 1 0**

(302) THE WHITE-BEAN AREA SCALE

(Patent No. $10231\frac{07}{}$.)

For the Rapid and Convenient Measurement of the Areas of Regular and Irregular Figures, Steam Indicator Diagrams, etc.



No. 302.

This new form of area scale has been designed for the rapid and convenient measurement of the area of any figure—regular or irregular. Its accuracy and simplicity in use render it particularly suitable for such purposes as obtaining the areas of **steam indicator diagrams,** and its

THE WHITE-BEAN AREA SCALE—Continued.

low price allows of its wide use among students in technical colleges and schools, as well as in every drawing office.

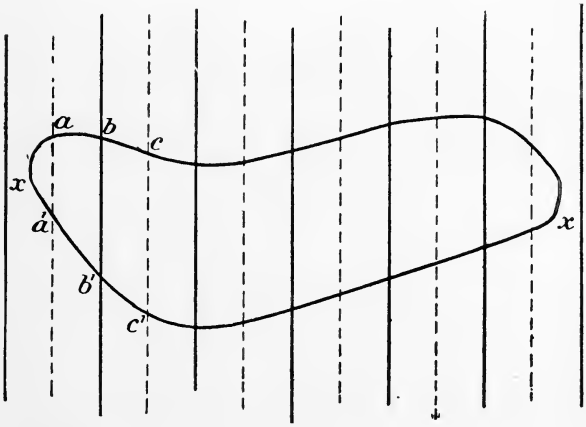
It is clearly and indelibly printed from a special die on transparent celluloid, and is made of the size experience has shown to be the most useful.

Instructions for Use

There are two methods of obtaining the area of a figure by means of the **White-Bean Area Scale;** the first being employed where **accuracy** is the chief factor, and the second where **rapidity** is more important than extreme accuracy.

We describe the former method first.

Longer Method



1. Place the celluloid scale over the figure of which the area is required in such a position that the extreme ends of the figure lie equidistant between two of the vertical lines of the scale—dotted or solid—as shown in the diagram above.

2. Lay a strip of paper over the area scale along the first line which intersects the figure, and mark this strip at the points of intersection $a\ a^1$; now move a^1 on the strip to the point b and mark off b^1; repeat this operation until the lengths of all the lines included in the boundary of the figure have been marked off on the strip.

THE WHITE-BEAN AREA SCALE—Continued.

3. Measure, on one of the two scales at the top of the instrument, the length of paper between the first and last mark. This will give the area of the figure directly, in square inches or square centimetres according to the scale used.

Shorter Method

Use only the dotted lines, or only the solid lines. Whichever may be decided on, the method of procedure is practically the same as in the former case.

Let us assume it is decided to use the solid lines.

1. Lay the scale over the figure so that the two extremes of the figures *x x* lie on dotted lines, as these are equidistant between the solid lines.

2. Proceed as in the longer method, No. 2, but using only the solid lines.

3. Same as in the longer method, operation No. 3, except that the result obtained will be half the area; to obtain the true area multiply the result by two; this method is quicker, but not quite so accurate as the former.

Advantages

The advantages claimed for the White-Bean Area Scale are as follows:—

With its aid the area of any irregular figure can be measured in the most rapid and convenient manner possible.

The scale gives results sufficiently accurate for all practical purposes.

The figure is not defaced or marked in any way.

It is of a convenient size—large enough to be easily read and yet small enough to be perfectly portable.

There are no delicate or moving parts to get out of order.

It is so simple to use that an area can be measured with it as easily as a length is with a foot rule.

Its low price brings it within the reach of everyone.

PRICE 3s. 6d.

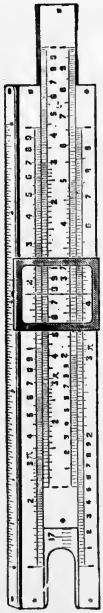
PRICE 3s. 6d.

SLIDE-RULES

A. W. FABER'S SLIDE-RULES

No. 303.

Faber's No. **361**,
11 in.

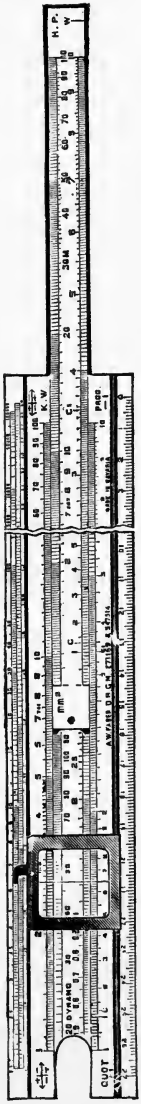


No. 304.

Faber's No. **369**,
$5\frac{7}{8}$ in.

Nos. 305 & 306.

Faber's Nos. **360** & **365**,
$10\frac{1}{4}$ in.



No. 311.

Faber's No. **368**,
11 in.

A. W. FABER'S SLIDE-RULES—Continued.

(303) **Calculating Rule** No. **361,** with decimals and with **ordinary cursor**; 11 in. **£0 5 0**

(304) Ditto No. **369,** pocket size, without decimals, with **ordinary cursor**; $5\frac{7}{8}$ in. **£0 5 0**

(305) Ditto No. **360,** with decimals and with **ordinary cursor**; $10\frac{1}{4}$ in. **£0 8 6**

(306) Ditto No. **365,** as above, but with **slide spring**; $10\frac{1}{4}$ in. **£0 9 0**

(307) Ditto No. **363,** with decimals, **slide spring** and **ordinary cursor**; 11 in.... ... ... **£0 10 6**

(308) Ditto No. **363½,** as No. 282, but with **registering cursor**; 11 in. **£0 10 6**

(309) Ditto No. **364,** without decimals, with **slide spring** and **ordinary cursor**; 11 in.... ... ... **£0 10 6**

(310) Ditto No. **367,** as No. 284, but with **registering cursor**; 11 in. **£0 10 6**

(311) Ditto No. **368,** for electrical and mechanical engineers, without decimals, with **slide spring, special cursor and log. log. scale**; 11 in. **£0 12 0**

(312) **Book of Instructions** for Faber slide-rules, 47 pp., 14 diagram sheets **£0 1 6**

NESTLER'S SLIDE-RULES

(313) **5**-inch **Rule,** mahogany, with celluloid back acting as a spring, open dividing... ... ... **£0 6 0**

(314) **5**-inch **Rule**, new pattern, close dividing, magnifying cursor **£0 8 6**

Owing to the magnifying cursor and close dividing this rule is equivalent to a 10-inch.

(315) **The "Student's" Slide-Rule,** 10 inch, boxwood, celluloid faced **£0 5 0**

(316) **The "Standard" Slide-Rule,** with rubber strip and celluloid back—

10	15	20	24 inch.
£0 10 0	**£1 7 0**	**£2 2 0**	**£2 16 0**

The 10 and 20 inch sizes can be supplied with movable side beam if desired, at the prices shown above.

317) **The "Rietz" Slide-Rule.** In addition to the ordinary scales, this rule has a scale on the upper edge giving cubes, cube roots, $N\frac{3}{2}$ and $N\frac{2}{3}$, while a scale on the lower edge gives the mantissæ of the logs. of the numbers on D.

10	15	20 inch.
£0 10 6	**£1 15 6**	**£2 10 0**

NESTLER'S SLIDE-RULES—Continued.

(318) **"Reitz" Slide-Rule,** new pattern, with movable side beam fitted with spring, 10 inch **£0 11 6**

(319) **The "Precision" Slide-Rule.** This is a 10-inch rule with the accuracy of a 20-inch, the increase in accuracy being obtained by dividing the 20-inch scale length into two parts and placing these on the working edges of the rule and slide. Price **£0 18 6**

(320) **The "Universal" Slide-Rule,** a convenient **10-inch rule** for surveyors and civil engineers, as it has scales giving sin n, cos n and cos ^2n, thus facilitating tacheometrical calculations. It has all the usual scales in addition to these. Price **£0 16 0**

(321) **The "Fix" Slide-Rule,** 10-inch. The A scale in this rule is displaced to the extent of $\frac{\pi}{4}$ so that 0·7854 on A is opposite to 1 on D. This enables calculations of cylinder areas and cubic contents to be readily determined. Price **£0 12 6**

The prices of all Nestler rules include cases and instruction books. Broken-line cursors supplied at an extra charge of 1s. 0d.

(322) **ANDERSON'S IMPROVED SLIDE-RULE**
(PATENTED.)

Sole Makers: C. F. CASELLA & CO., LTD.

VEALTHDRAWN

This invention renders the slide-rule a practicable instrument, indispensable to engineers, electricians, architects, surveyors, statisticians and others who have to deal in laborious calculations.

The rule is similar to the ordinary slide-rule, and consists of upper and lower limbs between which works the slide, a glazed cursor with hair-line travelling over all. The scales, however, instead of actually, or mentally, forming a series in one horizontal line, as in the ordinary slide-rule, are split up into series of parallel lines, the graduations of each line being separated from those of the next by a common geometric ratio.

A **leaflet** giving full particulars will be sent on application.

Price, with book of instructions and conversion tables ... **14s. 6d.**

Packing and postage to anywhere in the United Kingdom, **6d.** extra.

(322A) **Fuller's Spiral Slide-Rule,** equivalent to a rule 83 ft. long: in mahogany case **£3 0 0**

DRAWING INSTRUMENTS

MAGAZINE CASES

No. 323.

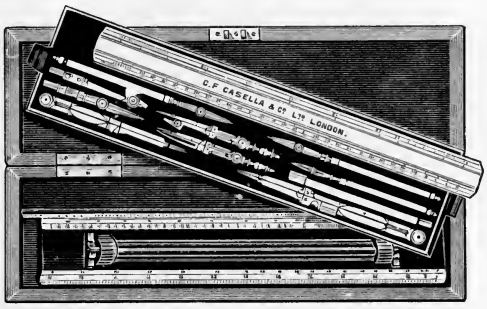
(323) **13-inch Magazine Case,** oak or walnut, velvet-lined, electrum-bound, lock and two keys, two trays, and tray for colours and brushes, containing the following instruments, all of the first quality:—

Beam compass.
6-inch proportional compass, fully divided.
6-inch double-jointed compass.
Ink, pencil and wheel points.
Two lengthening bars.
Hair-spring divider.
Sector jointed divider.
Double-jointed ink and pencil bows.
Three spring bows.
Opisometer.
Border pen, ivory handle.
Wheel pen, with assorted wheels.
Road pen.
Red ink pen.
Three jointed pens, assorted.
Three fine line pens, steel, assorted.
Set of six 12 inch chain scales and offsets, ivory.
Ivory protractor, fully divided.
Sector.
Parallel rule.
Rolling parallel rule, 12 inch, ebony with ivory edge.
Pricker, knife, key, etc.
All **needle points.**

Price **£18 18 0**

(324) Ditto, as No. 323, but with **boxwood**, instead of ivory, scales and offsets **£16 16 0**

MAGAZINE CASES—Continued.



No. 325.

(325) **13-inch Magazine Case**, oak or walnut, velvet lined, containing the following instruments :—

6-inch double-jointed compass.
Ink and pencil points.
Lengthening bar.
Hair-spring divider.
Double-jointed ink and pencil bows.
Two drawing pens.
Sector.
Parallel rule.
Rolling parallel rule, 12 inch, ivory edge.
Ivory protractor, fully divided.
Pricker, knife, key, etc.
All **needle points.**

£5 15 0

(326) Ditto, as No. 325, but in electrum-bound case and with special quality instruments **£7 15 0**

(327) Ditto, as No. 325, but with extra tray to hold colours, brushes, etc., and with beam compass; all needle points **£7 5 0**

(328) Ditto, as No. 327, but with the following additional instruments :—proportional compass, fully divided; wheel pen with six assorted wheels... ... ... **£9 0 0**

(329) Ditto, as No. 328, but with the following additions :—

Opisometer.
Road pen.
Red ink pen.
Bordering pen.
Six 12-inch boxwood chain scales and offsets.

£11 5 0

(330) **13-inch Magazine Case**, oak, velvet-lined, lock and key, containing the following electrum instruments :—6-inch double-jointed compass, ink and pencil points and lengthening bar, hair-spring divider, double-jointed ink and pencil bows, two drawing pens, pricker, 12-inch rolling parallel rule with ivory edge, 12-inch ivory scale, celluloid protractor **£4 16 0**

(331) Ditto, as No. 330, but with needle points **£5 2 6**

The last two sets are specially suitable for engineers.

7-INCH CASES, METAL-BOUND

No. 335.

(332) **Mahogany, Oak or Walnut Case**, metal-bound, velvet-lined, lock and key, containing :—

6-inch compass with double knee joints, ink and pencil points.
Lengthening bar.
Hair spring dividers.
Bow pen and pencil, jointed.
Two ivory drawing pens.
Ivory protractor.
Ivory parallel rule.

Electrum **£3 12 6**

(333) Ditto, as No. 332, but with needle points... „ **£3 18 0**

(334) Ditto, as No. 332, but with the following additional instruments :—

Three spring bows.
Ivory handle pricker.
Three ivory scales **or** one ivory protractor.
Sector and parallel rule.

Electrum **£4 10 0**

(335) Ditto, as No. 334, but with needle points ... „ **£4 16 6**

(336) Ditto, as No. 335, but with colour tray ... ... „ **£5 0 0**

(337) Ditto, as No. 335, but with beam compass (fine adjustment, ink and pencil points) ... ... „ **£6 0 0**

(338) Ditto, as No. 335, but with proportional compass, fully divided ... ... „ **£6 7 6**

7-INCH CASES, PLAIN

(339) **Mahogany Hook Case**, velvet-lined, with flap in lid, containing :—

6-inch compass, with ink and pencil points.
5-inch dividers.
Ivory drawing pen.
Boxwood protractor.
Ebony parallel rule.
Pencil.

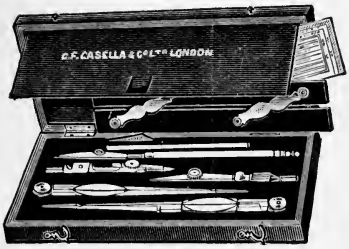
All best quality ... ... Electrum, **£0 10 6** ; Brass, **£0 9 6**

(See figure, page 85.)

(340) Ditto, as No. 339, but with jointed instruments.

Electrum, **£0 14 6** ; Brass, **£0 13 0**

7-INCH CASES, PLAIN—Continued.



No. 339.

No. ~~341~~. 356

(341) **Mahogany Case**, velvet-lined, lock and key, containing :—

6-inch compass, with pen and pencil points.	Ivory drawing pen.
5-inch dividers.	Boxwood protractor.
Bow pen and pencil.	Ebony parallel rule.
	Pencil.

All best quality ... ... Electrum, **£0 15 6**; Brass, **£0 14 6**

(342) Ditto, as No. 341, but with jointed instruments.
Electrum, **£1 8 6**; Brass, **£1 4 9**

(343) Ditto, as No. 341, but with best quality sector-jointed instrument, ivory instead of boxwood protractor, in **oak** or **walnut** case.
Electrum, **£2 10 6**; Brass, **£2 5 0**

(344) **Mahogany Case**, velvet-lined, lock and key, containing :—

6-inch compass, pen and pencil points.	Two ivory drawing pens.
Lengthening bar.	Boxwood protractor.
5-inch dividers.	Ebony parallel rule.
Bow pen and pencil.	Compass, key, etc.

Electrum, **£1 3 9**; Brass, **£1 1 6**

(345) Ditto, as No. 344, but with jointed instruments.
Electrum, **£2 1 6**; Brass, **£1 16 6**

(346) Ditto, as No. 344, but with knee joint to compass, and hair spring dividers ... ... Electrum, **£3 6 0**; Brass, **£3 0 0**

(347) Ditto, as No. 344, but with three spring bows in addition to the instruments mentioned... Electrum, **£1 17 6**; Brass, **£1 12 6**

(348) Ditto, as No. 347, but with sector-jointed instruments, ivory instead of boxwood protractor, and rule, in **oak** or **walnut** case.
Electrum, **£3 12 0**; Brass, **£3 4 6**

(349) Ditto, as No. 348, but with knee joint to compass, and hair spring dividers ... ... Electrum, **£3 18 6**; Brass, **£3 9 6**

PUBLIC SCHOOL AND COLLEGE SETS

(350) "**Addiscombe Case.**" 13-inch mahogany case, containing :—

6-inch compass, pen and pencil points.
Lengthening bar.
Dividers.
Two ivory drawing pens.
Ivory protractor, military pattern.
Sector.
Marquois scales.
Knife key, etc.

Electrum, **£3 7 6**; Brass, **£2 17 6**

(351) "**Military College Case.**" Mahogany case, containing :—

6-inch compass, sector-jointed, ink and pencil points.
Lengthening bar.
Improved dividers.
Improved bow pen and pencil.
Two ivory drawing pens.
Ivory protractor.
Sector.
Knife key, etc.

Electrum, **£2 18 6**; Brass, **£2 9 6**

(352) "**Sandhurst Case.**" Mahogany case, containing :—

6-inch compass, ink and pencil points.
Dividers.
Bow pen.
Drawing pen.
Key pencil.
Ivory protractor, military pattern, etc.

Electrum, **£1 17 6**; Brass, **£1 13 6**

(353) "**Royal School of Naval Architecture Case.**" Mahogany case, with lock and key, containing :—

6-inch compass, with one knee joint, ink and pencil points.
Lengthening bar.
Hair dividers.
Improved bow pen and pencil.
Steel upper nib pen.
Fine line steel pen.
Ivory protractor.
Ebony parallel rule.
Knife key, etc.

Electrum, **£3 0 0**

(354) "**Cooper's Hill Case.**" Walnut case, containing :—

6-inch compass, with double joints, ink and pencil points.
Lengthening bar.
Hair dividers.
Bow pen and pencil, double-jointed.
Ivory drawing pen, jointed.
Two ivory rules.
Knife, etc.

Electrum, **£4 2 6**

(355) **Reeves's Set of Drawing Instruments.**

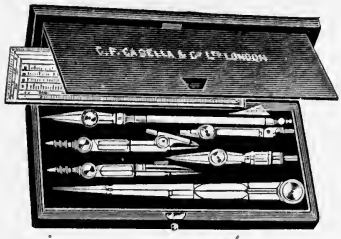
This set has been designed particularly to meet the requirements of explorers and geographical surveyors.

The instruments and materials contained in it have been selected and approved by Mr. E. A. Reeves, F.R.A.S., the Curator and Instructor in Practical Astronomy and Surveying to the Royal Geographical Society. Great attention has been paid to compactness and convenience in use. Contents :—

Reeves's Patent Proportional Dividers, with pen and pencil points (see pp. 94 to 98).
Drawing pen, ivory handle.
Mapping pen.
5 Water colours (half cakes).
Palette.
Drawing pins.
India rubber.
Pencils.
Brushes.
Knife.
Ivory parallel rule.
Diagonal scales.
Hinged circular protractor.
Etc., etc.

Price ... **£5 7 6**

POCKET CASES



No. 356. 341

4½-INCH INSTRUMENTS

(356) **Leather Case**, containing :—

4½-inch compass, electrum, pen and pencil points.
Ivory drawing pen.
Boxwood protractor.
Compass key.

Best quality, electrum **£0 15 6**

(357) Ditto, as No. 356, but with sector-jointed instruments, turn-up nibs to pens, knife file, and ivory instead of boxwood protractor; best quality electrum **£1 11 6**

(358) **Leather Case**, containing :—

4½-inch compass, pen and pencil points.
Bow pen and pencil.
Ivory drawing pen.
Boxwood protractor.

Best quality electrum, steel joints **£1 6 6**

(359) Ditto, as No. 358, but with sector-joints, turn-up nibs, ivory instead of boxwood protractor, knife key, etc. ... **£2 0 0**

(360) **Leather Case**, containing :—

4½-inch compass, pen and pencil points.
Lengthening bar.
4-inch dividers.
Bow pen and pencil.
Two ivory drawing pens.
Boxwood protractor.
Ebony parallel rule.

Ordinary quality, electrum **£1 5 6**

(361) Ditto, as No. 360, but better quality instruments and case **£1 13 6**

(362) Ditto, as No. 360, but with double knee joints to compass and bows, hair dividers, turn-up nibs to pens, ivory protractor and parallel rule. Ordinary quality, electrum **£3 10 6**

(363) Ditto, as No. 362, but best quality **£4 0 0**

(364) Ditto, as No. 362, but with needle points, ordinary quality, electrum **£3 17 6**

(365) Ditto, as No. 364, but best quality **£4 7 6**

POCKET CASES—Continued.

5 AND 9-INCH INSTRUMENTS

(366) **Morocco Case**, containing :—

5-inch double-jointed compass, pen and pencil points.
Lengthening bar.
Three spring bows.
Ivory drawing pen, turn-up nib.
Knife key.

Best quality, electrum, needle points **£1 18 6**

(367) **Morocco Case**, containing :—

6-inch steel joint compass, pen and pencil points.
Plain dividers.
Pen and pencil bows.
Drawing pen.
Compass key.
Pencil.

Ordinary quality, electrum **£0 17 6**

(368) Ditto, as No. 367, but best quality **£1 3 6**

(369) Ditto, as No. 367, but with three spring bows; ordinary quality **£1 3 6**

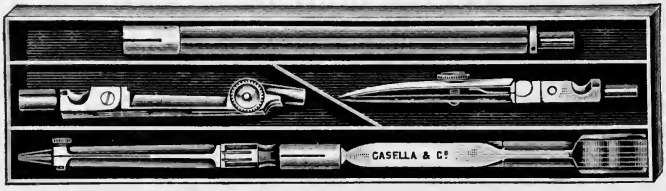
(370) Ditto, as No. 369, best quality **£1 11 6**

(371) **Morocco Case**, containing :—

6-inch double-jointed compass, pen and pencil points.
Lengthening bar.
Hair-spring dividers.
Bow pen and pencil.
Two drawing pens.
Ivory protractor.
Knife file, etc.

Best quality, electrum, needle points **£3 0 0**

(372) Ditto, as No. 371, but with three spring bows in addition to the instruments named **£3 10 0**



HALF SETS OF COMPASSES

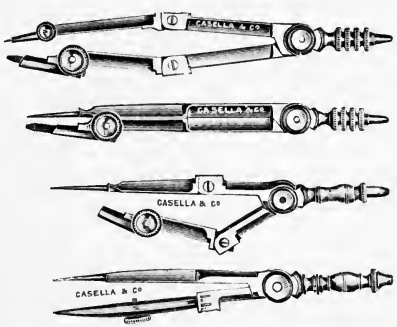
In two sizes—4½ and 6 inches.

	Electrum, best quality.	Electrum, ordinary quality.	Brass.
(373) **Compass,** ink and pencil points	—	**£0 7 0**	—
(374) Ditto, with slip shank fittings and lengthening bar	—	**£0 10 0**	**£0 8 6**

HALF SETS OF COMPASSES—Continued.

	Electrum, best quality.	Electrum, ordinary quality.	Brass.
(375) **Compass**, sector joint, ink and pencil points, lengthening bar and key	£1 0 0	£0 16 6	£0 13 6
(376) Ditto, as No. 375, but with one knee joint	£1 3 0	£0 19 6	—
(377) **Compass**, sector joint, with double knee joints, ink and pencil points, lengthening bar and key	£1 7 6	£1 2 0	—
(378) Ditto, as No. 377, but with needle points	£1 11 6	£1 5 6	—
(379) Ditto, as No. 377, but with nut and bolt needle points	£1 18 6	£1 10 0	—
(380) Ditto, as No. 377, but with screw-off needle points...	£1 18 6	£1 10 0	—

BOWS



Nos. 381-388.

In two sizes—3 inches and $3\frac{3}{4}$ inches.

(381) **Plain Bows,** not jointed, ink or pencil; electrum, best quality £0 3 0

(381A) Ditto, improved pattern; electrum, best quality ... £0 4 0

(382) **Double Jointed Bows,** improved pattern, plain points, ink or pencil. Electrum, best quality £0 8 0

(383) Ditto; electrum, ordinary quality £0 6 0

(384) Ditto, needle points; electrum, best quality £0 8 0

(385) Ditto; electrum, ordinary quality £0 7 0

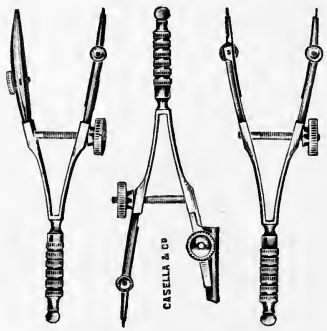
BOWS—Continued.

(386) **Double Jointed Bows,** improved pattern, nut and bolt needle points, ink or pencil sector joints; electrum, best quality... ... ... **£0 10 0**

(387) Ditto; electrum, ordinary quality **£0 7 6**

(388) Ditto, but with screw-off needle points; electrum, best quality... ... ... **£0 10 6**

SPRING BOWS



No. 392.

In two sizes—2½ inches and 3 inches.

(389) **Spring Bows**, set of three, ink, pencil and dividers, in leather case, small; electrum, best quality **£0 12 0**

(390) Ditto; electrum, ordinary quality **£0 10 0**

(391) Ditto, but 3¾ inches, in leather case; electrum, best quality... ... ... **£0 17 6**

(392) **Spring Bows,** 2½ or 3 inches, set of three, ink, pencil and dividers, needle points, in case; electrum, best quality **£0 17 0**

(393) Ditto; electrum, ordinary quality **£0 14 0**

(394) Ditto, but nut and bolt needle points; electrum, best quality... ... ... **£0 17 6**

(395) Ditto; electrum, ordinary quality **£0 14 0**

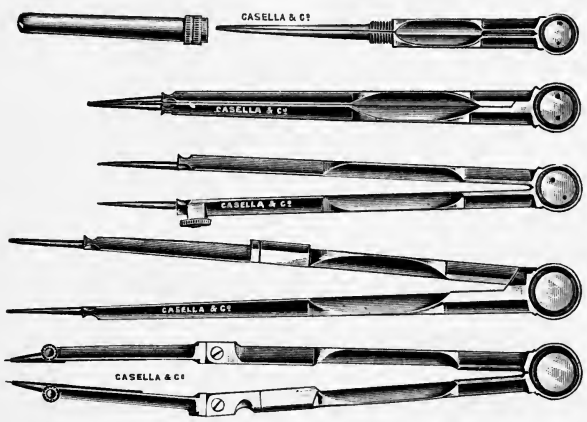
SPRING BOWS—Continued.

(396) Ditto, as No. 392, but with screw-off needle points; electrum, best quality **£1 3 0**

(397) **Spring Bows**, set of three, with double-action inside screw, in leather case; electrum, best quality **£1 6 6**

(398) **Revolving Spring Bow,** for small circles, pen and pencil, in case **£0 15 6**

DIVIDERS



Nos. 399-405.

	Electrum, best quality.	Electrum, ordinary quality.	Brass.
(399) **Dividers**, plain long joint, 4 or 5 inches ... ... A cheaper quality can also be supplied from 1s. 6d. each.	**£0 3 6**	**£0 3 0**	**£0 2 9**
(400) Ditto, sector joint	**£0 4 0**	**£0 3 6**	**£0 3 3**
(401) Ditto, as No. 399, but 6 inch ...	**£0 5 9**	—	—
(402) Ditto, as No. 399, but 9 inch ...	**£0 10 0**	—	**£0 8 0**
(403) **Dividers**, sector joint, with improved hair-spring point, 4 or 5 inch	**£0 7 6**	**£0 7 0**	**£0 6 0**
(404) **Dividers**, sector joint, with sheath for points, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4 or 5 inch...	**£0 8 6**	—	—
(405) **Dividers**, sector joint, with hair spring, inside screw adjustment			**£0 8 6**

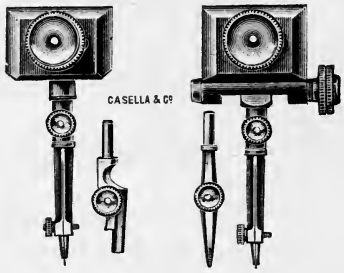
BEAM COMPASSES

(406) **Beam Compass,** to fit any lath ; electrum **£0 10 6**

(407) Ditto, with fine screw adjustment **£0 15 0**

(408) Ditto, as No. 407, but with needle points **£0 17 6**

(409) Ditto, as No. 408, but better quality and with nut and bolt needle points **£0 19 6**



No. 407.

(410) **Morocco or Mahogany Cases** for the above, extra ... **£0 4 0**

(411) **Boxwood Beam Lath** for the above—

24	30	36	48	60 inches.
8d.	**10d.**	**1s. 2d.**	**1s. 8d.**	**2s. 6d.**

	Electrum and Wood.	Brass and Wood.
(412) **Beam Compass, Ordnance pattern,** 4 ft., divided to read to 0·1 in.	**£2 5 6**	**£1 17 6**
(413) Ditto, as above, but with fine adjustment and vernier	**£3 3 0**	**£2 10 0**

(414) **Beam Compass, Woolwich pattern,** bronzed metal, 3 ft., divided to 0·1 in., and reading by vernier to 0·01 in., with fine adjustment to each head. In polished mahogany case **£3 10 0**

TUBULAR COMPASSES

(415) **Tubular Compass,** best quality, revolving pen and pencil, needle points **£1 18 6**

(416) Ditto, but with bolt and nut, or screw-off, needle points **£2 0 0**

(417) **Leather Case** for the above **£0 2 6**

POCKET COMPASSES AND DIVIDERS

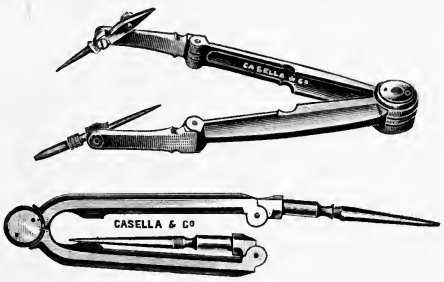
(418) **Pillar Compass,** forming set of instruments, in case; electrum, best quality **£1 11 6**

(419) Ditto, ordinary quality **£1 8 6**

Needle points, **2**/- extra.

(420) Ditto, as No. 418, but with lengthening bars **£1 18 6**

(421) Ditto, as No. 420, but with needle points **£2 0 0**



No. 422.

(422) **Napier Compass,** three sizes: large, medium and small, revolving pen and pencil points, in case; electrum, best quality... ... ... **£1 0 0**

(423) Ditto, ordinary quality **£0 17 6**

Needle points, **4**/- extra.

(424) Ditto, as No. 422, with pen and pricker, needle points; in case... ... ... **£1 12 6**

(425) **Napier Compass,** with ivory pen and pricker and two spring bows, in leather case; electrum, best quality... **£2 0 0**

(426) **Napier Dividers,** large, medium and small size; electrum **£0 10 6**

(427) **Pillar Dividers,** pocket, large size; electrum **£0 11 0**

(428) **Bisecting Compass,** electrum, best quality... ... ... **£0 18 6**

(429) **Triangular Compass,** fixed leg; electrum, best quality **£0 12 6**

(430) Ditto, sliding bar... ... ... **£0 16 6**

REEVES'S PATENT PROPORTIONAL DIVIDERS

(Patent Application No. 8198$\frac{10}{\text{---}}$).

Sole Makers: C. F. Casella & Co., Ltd., London.

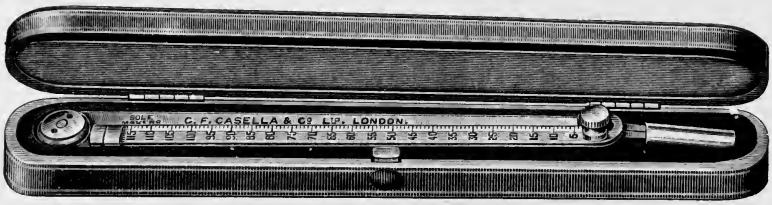


Fig. 1.

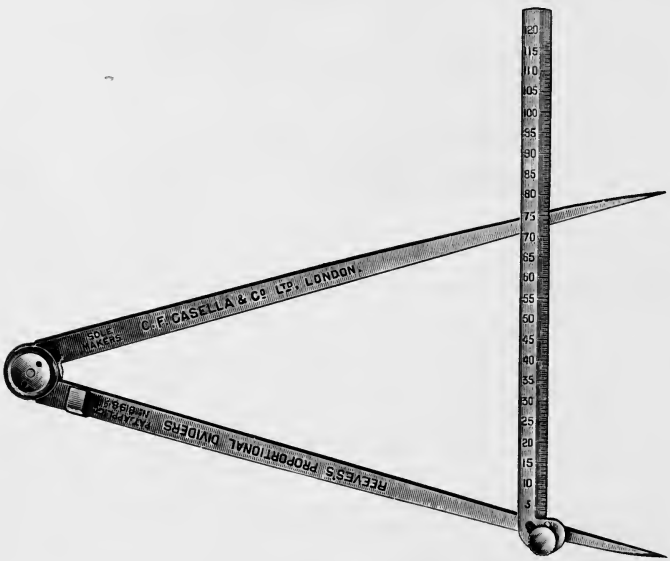


Fig. 2.

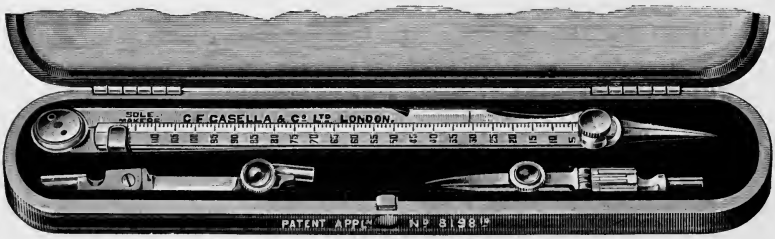


Fig. 3.

REEVES'S PROPORTIONAL DIVIDERS—Continued

This is an extremely useful and simple little instrument for surveyors, cartographers, engineers, architects and draughtsmen of all kinds.

It consists of an ordinary pair of compasses or dividers, fitted with a movable scale, by means of which proportional measurements can be made, lines divided into any number of parts, and latitudes and longitudes accurately read off maps and charts. It will serve as a diagonal scale or vernier for exact measurements of various kinds, and can be put to numerous other uses. As will be seen from the illustrations, it is extremely neat and compact, and the special arrangement does not interfere with the use of the compasses for ordinary purposes.

Some of the principal uses of this instrument are as follows :—

(1) To find what proportion any part of a line bears to the whole line :—

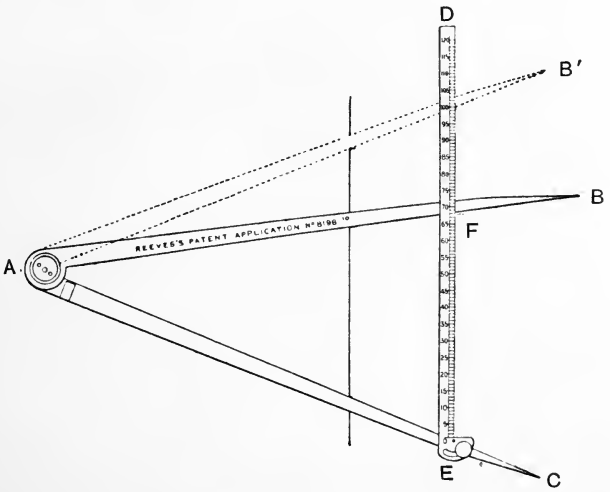


Fig. 4.

Open the divided arm D E to any convenient position and clamp it. Move the arm A B until its inner edge accurately cuts the 100th division on the scale of D E. Then with the arms thus set, place the instrument so that the whole line is exactly enclosed between the inner edges of the two arms A B and A C, at the same time being careful to see that the

REEVES'S PROPORTIONAL DIVIDERS—Continued

line is as near as possible parallel with the arm D E. With the fingers of the left hand on the arm A C to keep it in position, move the arm A B until its inner edge intersects the portion of the line to be measured, and read off the scale. This reading will be the fraction of this line, or the proportion it bears to the whole to two decimals, and to three by estimation. Thus suppose the reading to be 68, this means that the measured portion is 0·68 of the whole line. If it had read 68·5 it would have been 0·685 of the line.

By reversing this process any required portion of a line can be marked off.

(2) To find the exact latitude and longitude of a place on a map:—

Suppose the latitude be required, and the parallels to be one degree apart: Open the arm D E to any suitable position and clamp. Move the arm A B till it exactly intersects the 120th division on D E. Then place the instrument so that the whole degree is accurately included between the inner edges of the two arms A B and A C, at the same time placing it so that the arm D E is parallel with the meridian passing through the place. Now, holding the arm A C firmly, move the arm A B until its inner edge exactly coincides with the place on the map of which the latitude is required, and read off the figures. Say this reading was 55, then this, divided by two, equals 27·5, or 27′-30″, which is the measure required. For small scale maps the divided arm may be set at 60 instead of 120, in which case it will not be necessary to divide it by 2.

The same will of course hold good for longitudes, and by reversing the operation exact latitudes and longitudes can be laid down on maps and charts.

(3) To divide a line into any number of equal parts:

Open the arm D E to any convenient position, and clamp. Set the arm A B to the number of parts required (or to any convenient multiple of this number.) Place the instrument so that the inner edges of A B and A C accurately include the whole line to be divided, when the arm D E is parallel with this line. Hold the arm A C fast and move the arm A B down from one mark to another, pricking off with a needle point the exact position of the inner edge of A B on the line.

REEVES'S PROPORTIONAL DIVIDERS.—Continued

(4) To convert linear scales of maps from one measure to another, as for instance, kilometres into statute miles.

Open the arm D E to any convenient position and clamp. Set the arm A B to the number on the arm D E equal to the number of statute miles in any given number of kilometres on the map scale (62·14 statute miles=equals 100 kilometres) and then with the compass flat on the map enclose this number of kilometres on the scale exactly between the two arms A B and A C, at the same time placing the arm D E as nearly parallel as the eye can detect, with the scale on the map. Then holding the arm A C firm, set the other arm A B to any number of kilometres on the scale, and the equivalent number of statute miles will be shown by the divisions on the arm D E.

The instrument may be used in a similar manner to work out any proportion, provided the lengths come within its range.

(5) To divide a line proportionally when the measures of the two extremes and of a point between them are known.

Let it be desired to mark off on the line *a b* (fig. 5) divisions that increase proportionally with the length, and for example, let the points 0 and 100 be the extreme points and 50 a given point between them, but not in the centre. Open the compass to any convenient length, and set the divided arm D E so that the arm A B intersects it exactly at the 100th division, and clamp it. With the instrument placed flat on the paper, turn it bodily until it is in such a position that the points 0 and 100 on the line *a b*, are exactly included between the arm A B and A C, and at the same time so that the arm A B will, when moved down, intersect the 50 on the line *a b*, and the 50 on the divided arm D E. Then holding the arm A C firm, move the arm A B down the scale on D E, and as each division is reached mark it off on the line *a b*, which will then be proportionally divided, as in the example (fig. 5).

These are only a few of the uses to which this instrument can be put, but many others will suggest themselves.

REEVES'S PROPORTIONAL DIVIDERS.—Continued

The divisions are either 20 or 25 to an inch, according to the size, so that the scale D E constitutes a very exact measure of inches and decimals of an inch, for the purpose of ordinary measurement.

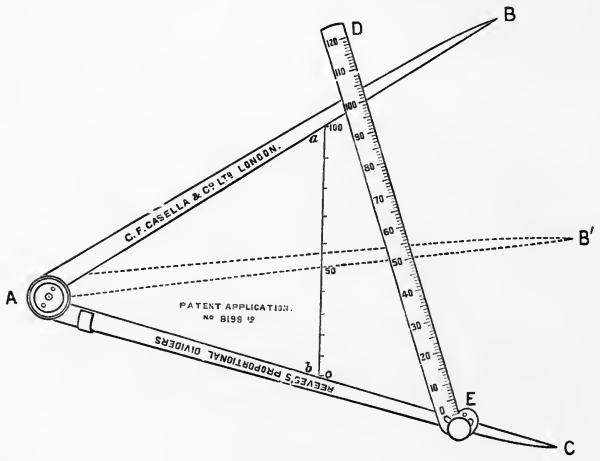


Fig. 5.

In addition to its special use for proportional measurements and readings, as shown above, this instrument serves all the purposes of ordinary compasses, and can be obtained in a neat pocket case with pencil and pen points, or separate, as required. It can also be fitted into any ordinary case of mathematical instruments.* It is made in two sizes—7 inches long with 25 divisions to an inch, or 9 inches long with 20 divisions to an inch.

Prices.

(431) **Simple form**, as shown in fig. 1, page 94—

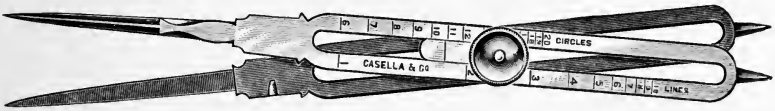
7 inch, **£1 5 6** ... 9 inch, **£1 12 6**

(432) **With pen and pencil points,** as fig. 3, page 93—

7 inch, **£1 16 6** ... 9 inch, **£2 5 0**

* See No. 355, page 86.

PROPORTIONAL COMPASSES



No. 434.

(433) **Proportional Compass**, 6 inch, in maroon or leather case, divided for lines only; electrum, best quality ... **£1 2 6**

(434) Ditto, 6 inch, four scales; fully divided **£1 7 6**

(435) Ditto, 6 inch, as No. 434, but with points that may be set; electrum, best quality **£1 13 6**

(436) Ditto, 6 inch, as No. 434, but with bar adjustment; electrum, best quality **£1 13 6**

(437) **Proportional Compass**, 9 inch, four scales, in case; electrum, best quality **£1 15 6**

(438) Ditto, with points that may be set **£2 5 6**

(439) Ditto, as No. 437, but with bar adjustment **£2 12 6**

DRAWING PENS

All fitted with Ivory Handles

No. 443.

No. 446.

No 447.

No. 449.

No. 450.

No. 451.

DRAWING PENS—Continued

		Electrum, best quality.	Electrum, ordinary quality
(440)	**Drawing Pen**, round handle, fine steel	£0 2 0	£0 1 9
(441)	**Drawing Pen,** taper handle, extra fine...	£0 2 3	—
(442)	**Drawing Pen**, round handle, turn-up nib, 4½ or 6 inch	£0 3 3	£0 3 0
(443)	Ditto, as No. 442, but with square handle	£0 4 0	£0 3 6
(444)	Ditto, square handle, improved construction	£0 2 9	£0 2 3
(445)	Ditto, solid steel turn-up nib, extra stout back ...		£0 5 6
(446)	**Drawing Pen**, all electrum, for red ink ... ...each		£0 3 0
(447)	**Pricker**, nut and bolt needle point, with reservoir in handle for needles...		£0 2 6
(448)	**Tracer**, ivory handle, solid steel		£0 2 0
(449)	**Dotting or Wheel Pen**, electrum, 4 wheels		£0 8 0
(450)	**Road or Double Pen**		0 5 6
(451)	**Ditto, Pencil**		0 5 6
(452)	**Bordering Pen,** stout...		0 5 9
(453)	**Brick Gauge,** ⅛ or ¼ scale, 2 points...		0 2 3
(454)	**Ditto,** ditto, 4 points...		0 3 9

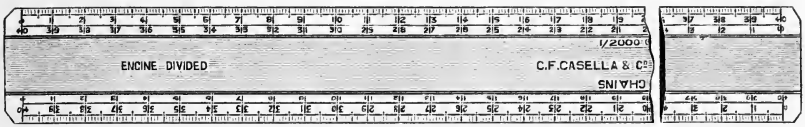
SETS OF DRAWING PENS

		Electrum, best quality.
(455)	**Set of 3 Steel Pens,** one ivory handle, in Morocco case	£0 9 0
(456)	**Set of 6 Ditto**	0 15 6
(457)	**Set of 3 Pens,** as No. 455, but with turn-up nibs ...	0 13 0
(458)	**Set of 6 Pens,** 3 ordinary and 3 jointed, in Morocco case	1 0 0
(459)	**Ditto,** as No. 458, but with turn-up nibs	1 4 0

SCALES

CHAIN SCALES

FLAT SECTION



	Ivory.	Opaque Celluloid.	Boxwood.
(460) **Chain Scale,** 6 inch, **fully divided** both edges, 1 to 6 chains to the inch, **flat section**	£0 4 6	£0 2 0	£0 1 4
(461) **Ditto,** 12 inch	0 9 6	0 3 9	0 2 3
(462) **Ditto,** 18 inch	—	—	0 4 0
(463) **Ditto,** 24 inch	—	—	0 7 0
(464) **Ditto,** 6 inch, as No. 460, but with 60 to 100 divisions to the inch	0 5 0	0 3 3	0 1 9
(465) **Ditto,** as No. 464, but 12 inch	0 11 0	0 4 0	0 2 6
(466) **Ordnance Survey Scale,** 12 inch, **fully divided** both edges, with any of the following scales :—6 inch, 12 inch, 5 feet and 10 feet to a mile, 25·344 inch to a mile, $\frac{1}{2500}$, 10·56 feet to a mile, $\frac{1}{500}$, 11, 22, 44 and 88, in feet and links on one scale, or crossed	—	£0 3 9	£0 2 3
(467) **Ditto,** 18 inch	—	—	0 4 0

CHAIN SCALES—Continued

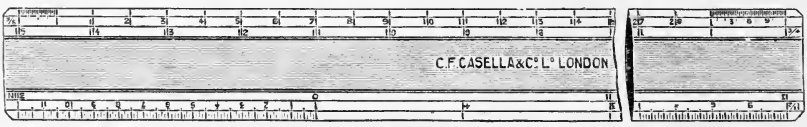
(468) **Metric Scale,** 12 inch, **flat section, fully divided,** ·001, ·002, ·003, etc., and $\frac{1}{1000}$, $\frac{1}{2000}$; $\frac{1}{300}$, $\frac{1}{400}$; $\frac{1}{500}$, $\frac{1}{600}$; both edges alike, or metric one side, equivalent feet the other,

	Ivory.	Opaque Celluloid.	Boxwood.
	£0 9 6	£0 3 9	£0 2 3

(469) **Foreign Scale,** 12 inch, any graduation, **flat section,** fully divided £0 10 6 £0 4 6 £0 3 0

ARCHITECTS' AND ENGINEERS' SCALES

FLAT SECTION

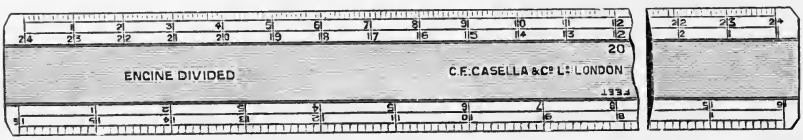


FULLY DIVIDED

(470) **Architect's Scale, 12 inch, fully divided,** both edges alike, or one scale on each edge; usual scales, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 inch; $\frac{1}{16}$, $\frac{3}{16}$, $\frac{3}{8}$, $\frac{3}{4}$, 3 inch, etc.

	Ivory.	Opaque Celluloid.	Boxwood.
	£0 9 6	£0 3 9	£0 2 3
(471) **Ditto,** open divided	£0 9 6	£0 3 9	£0 2 3
(472) **Ditto,** as No. 470, but 18 inch	—	—	£0 4 6
(473) **Ditto,** as No. 471, but 18 inch	—	—	£0 4 6

OVAL SECTION



OPEN DIVIDED

(474) **Architect's Scale,** as No. 470, but oval section, **12 inch, fully divided**—

	Ivory.	Opaque Celluloid.	Boxwood.
4 scales	£0 10 0	£0 4 0	£0 2 6
8 scales	0 10 3	0 4 3	0 2 9

ARCHITECTS' AND ENGINEERS' SCALES—Continued

	Ivory.	Opaque Celluloid.	Boxwood.
(475) **Ditto, open divided**—			
4 scales	£0 10 0	£0 4 0	£0 2 6
8 scales	0 10 3	0 4 3	0 2 9
(476) **Ditto,** as No. 474, but **18 inch**—			
4 scales	—	—	£0 4 6
8 scales	—	—	0 5 0
(477) **Ditto,** as No. 475, but **18 inch**—			
4 scales	—	—	£0 4 6
8 scales	—	—	0 5 0

UNIVERSAL SCALES

(478) **Builder's Universal Scale,** 6 inch, 16 scales	£0 5 6	£0 3 3	£0 1 9
(479) **Ditto,** 12 inch	0 9 6	0 3 9	0 2 3
(480) **Architect's Universal Scale,** 6 inch, 17 scales ...	0 6 0	0 3 6	0 2 0
(481) **Ditto,** 12 inch	0 10 0	0 4 3	0 2 9

TRIANGULAR SCALES

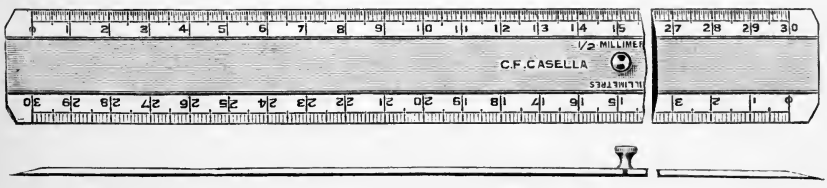
(482) **Triangular Scale,** 6 inch, with the following open divided scales :—$\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 3, $\frac{1}{5}$, $\frac{1}{10}$ ... £0 3 6

(483) **Ditto,** 12 inch 0 6 6

(484) **Ditto,** 6 inch, as No. 482, but with the following chain scales : 10, 20, 30, 40, 50, 60 ... ... 0 3 6

(485) **Ditto,** 12 inch 0 6 6

MISCELLANEOUS SCALES



No. 489.

(486) **Gunter's Scale,** 24 inch, boxwood £0 4 6

	Ivory.	Boxwood.
(487) **Sector,** 6 inch	£0 7 6	£0 5 6

MISCELLANEOUS SCALES—Continued

	Ivory.	Boxwood.
(488) **Double Decimetre Scale,** divided mm. one side, ½ mm. the other, with knob	£0 8 6	£0 1 9
(489) **Triple** Ditto (see fig., p. 103)	0 10 6	0 2 3

OFFSETS

	Ivory.	Opaque Celluloid.	Boxwood.
(490) **2-inch Offset** for scale up to 60 divs. per inch	£0 2 0	£0 1 0	£0 0 6
(491) **Ditto,** 60 to 100 divs. ...	0 2 6	—	—
(492) **3-inch Ditto**	0 3 0	—	0 1 0
(493) **2-inch Offset for Triangular Scale** up to 60 divs. ...	0 6 0	—	0 1 3
(494) **Ditto,** 60 to 100 divs. ...	0 7 0	—	—

SETS OF SCALES, IN CASES

	Ivory.	Boxwood.
(495) **Three 6-inch Chain Scales,** 10 and 20, 30 and 40, 50 and 60, in leather case	£0 15 0	£0 6 6
(496) **Six 6-inch ditto**...	1 10 0	0 11 0
(497) **Three 12-inch Chain Scales,** with offsets, in cloth case	1 12 6	0 11 0
(498) **Six 12-inch ditto,** in mahogany case ...	3 12 6	1 0 0
(499) **Six 12-inch Metric Scales,** with offsets, in mahogany case	3 15 0	1 2 6
(500) **Ditto,** with English scale on one edge ...	3 15 0	1 2 6
(501) **Six 12-inch Architects' Scales,** fully divided, in mahogany case	3 3 0	0 18 6
(502) **Marquois Scales, Set of,** in mahogany case...		£0 7 6
(503) **Ditto,** military pattern		0 10 0

SETS OF SCALES, IN CASES—Continued

(504) **Cardboard Scales,** new series of 12 of technical scales by C. F. Mitchell, Esq., comprising the following :—

A Full size and half full size.
B $\frac{1}{6}$ and $\frac{1}{3}$ full size.
C $\frac{1}{8}$,, $\frac{1}{4}$,,
D $\frac{5}{96}$,, $\frac{5}{48}$,,
E $\frac{1}{24}$,, $\frac{1}{12}$,,
F $\frac{1}{32}$,, $\frac{1}{16}$,,
G $\frac{1}{96}$,, $\frac{1}{48}$,,
H inches and half-inches into tenths, and diagonal scale to hundredths.
I $\frac{1}{3}$ and $\frac{1}{6}$ inches into tenths.
J $\frac{1}{4}$,, $\frac{1}{8}$,, ,, ,,
K metric, full size and half full size.
L metric, $\frac{1}{4}$ full size and $\frac{1}{8}$ full size.

Price per set **£0 1 0**

Each scale from A to G has a **scale of chords** measuring **degrees,** and each scale from I to L has a **scale of chords** measuring **radians** and hundredths of a radian.

COMPUTING SCALES

(505) **Computing Scale,** containing any two scales... ... ... **£0 16 0**

(506) **Universal Computing Scale,** containing 1, 2, 3, 4, 5, 6 chains to an inch, complete in mahogany case **2 10 0**

(507) Extra scales to fit the above **0 4 6**

PARALLEL RULES

PARALLEL RULES, ROLLING PATTERN

No 510.

(508) **Plain Ebony—**

6	9	12	15	18	24	Inches.
4s. 6d.	**5s. 3d.**	**6s. 0d.**	**7s. 6d.**	**9s. 0d.**	**15s. 0d.**	Each.

(509) **Ebony, with Celluloid Edges—**
8s. 0d. 9s. 0d. 11s. 3d. 13s. 3d. 16s. 0d. £1 2 0 ,,

(510) **Ebony, with Brass Bridge—**
8s. 0d. 10s. 0d. 13s. 0d. 14s. 0d. 15s. 0d. £1 7 0 ,,

(511) **Ebony, with Brass Bridge and Celluloid Edges—**
10s. 6d. 13s. 6d. 17s. 0d. 19s. 6d. £1 2 0 £1 15 0 ,,

(512) **Solid Brass—**
10s. 6d. 12s. 6d. 16s. 0d. 19s. 0d. £1 2 0 £1 12 6 ,,

PARALLEL RULES, BAR PATTERN

(513) **Ebony,** brass bar, best quality—

6	9	12	15	18	24	Inches.
1s. 0d.	**1s. 6d.**	**2s. 0d.**	**2s. 6d.**	**3s. 0d.**	**5s. 0d.**	Each.

(514) **Ebony,** electrum bar, best quality—

1s. 3d.	**2s. 0d.**	**2s. 6d.**	**3s. 3d.**	**4s. 0d.**	**6s. 0d.**	,,

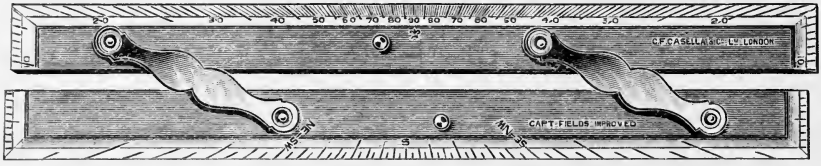
(515) **Ivory,** electrum bar—

5s. 0d.	—	—	—	—	—	,,

FIELD'S PARALLEL RULES, ROLLING PATTERN

	Inches	12	15	18	24
(516)	**Plain Ebony ... ...**	**£0 9 0**	**£0 10 6**	**£0 12 0**	**£0 18 0**
(517)	**Ebony, with Brass Bridge Mounts ...**	**0 16 6**	**0 18 0**	**1 0 0**	**1 11 6**
(518)	**Ebony, with Brass Bridge Mounts and Ivory Edges ... ...**	**1 1 6**	**1 3 0**	**1 7 6**	**2 5 0**

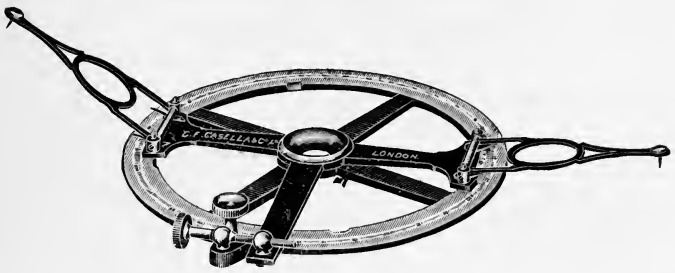
FIELD'S PARALLEL RULES, BAR PATTERN



	Inches	12	15	18	24
(519)	**Boxwood, Brass Bars**	**£0 4 3**	**£0 5 0**	**£0 6 0**	**£0 9 0**
(520)	**Ditto, German Silver Bars ... ...**	**0 4 6**	**0 5 6**	**0 7 0**	**0 10 0**
(521)	**Ebony, Brass Bars ...**	**0 4 6**	**0 5 6**	**0 7 0**	**0 10 0**
(522)	**Ditto, ditto, Ivory Edges ... ...**	**0 11 0**	**0 13 0**	**0 16 6**	**1 0 0**
(523)	**Ebony, German Silver Bars ... ...**	**0 5 6**	**0 7 0**	**0 9 0**	**0 11 6**
(524)	**Ditto, Ditto, Celluloid Edges ... ...**	**0 8 0**	**0 10 6**	**0 12 0**	**0 15 0**
(525)	**Ditto, Ditto, Ivory Edges ... ...**	**0 11 6**	**0 14 6**	**0 16 6**	**1 3 6**

PROTRACTORS

CIRCULAR AND SEMI-CIRCULAR



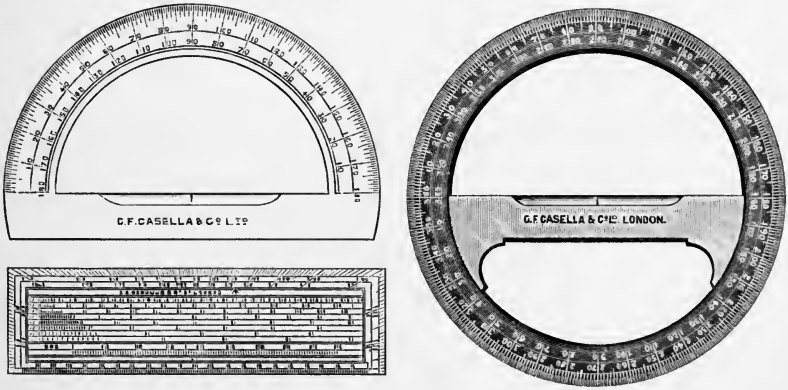
No. 527

(526) **6**-inch **Circular Protractor**, divided on silver, with folding arms, tangent screws, and **two verniers** reading to minutes. In mahogany case—

Brass or Gun-metal	Electrum
£5 15 0	**£7 2 6**

(527) **6**-inch Ditto, circular or semi-circular, divided on silver, with **one arm and vernier** reading to minutes. In mahogany case—

Brass or Gun-metal	Electrum
£2 12 6	**£3 7 6**



Nos. 528—530

(528) **Circular Protractors**, engine divided—

	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
German silver	**0 16 6**	**1 0 0**	**1 3 6**	**1 11 6**	**1 17 6**	**2 10 0**
Brass	**0 14 6**	**0 16 6**	**1 0 0**	**1 10 0**	**1 12 6**	**2 5 0**
Celluloid, opaque or transparent...	**0 7 0**	**0 8 0**	**0 9 0**	**0 10 0**	**0 11 6**	**0 15 0**
Mahogany cases for the above...	**0 2 6**	**0 2 9**	**0 3 0**	**0 3 6**	**0 4 0**	**0 5 0**

PROTRACTORS—Continued

(529) **Semi-Circular Protractors**, engine divided—

	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.
German silver	0 9 0	0 10 0	0 12 0	0 14 0	0 18 6	1 3 6
Brass	0 8 0	0 9 0	0 10 0	0 12 6	0 16 6	1 0 0
Celluloid, opaque or transparent...	0 4 0	0 4 6	0 5 0	0 5 6	0 6 6	0 7 3

RECTANGULAR

(See fig., page 107.)

	Boxwood.	Ivory.
(530) **Rectangular, 6-inch, ordinary**, four-line ...	£0 1 0	£0 4 6
(531) Ditto, **6-inch, ordinary**, eight-line	0 1 6	0 6 0
(532) Ditto, **6-inch, new Service** pattern	0 2 0	0 7 6
(533) Ditto, **6-inch, Aldershot**, with plummet ...	0 4 0	—
(534) Ditto, **6-inch, Sandhurst**, with plummet, in leather case	0 8 0	—
(535) Ditto, **6-inch, Gunter's**	0 4 6	0 12 0

MAP MEASURERS

(See figs., page 109.)

(536) **Opisometer**, ordinary pattern £0 3 0

(537) **Ditto**, better quality 0 5 0

(538) **Ditto**, improved pattern, divided into feet, inches and tenths 0 15 0

(539) **Ditto**, as No. 538, but divided 6 inches to a mile 0 16 0

(540) **Leather Case** 0 1 0

(541) **Rotameter**, universal, with straight handle 0 4 6

(542) **Ditto**, with ring instead of handle 0 5 0

MAP MEASURERS—Continued

No. 543. No. 542. No. 537. No. 538.

(543) **Ditto,** as No. 542, but with extra dial for counting the revolutions of the pointer... ... ... **£0 6 6**

(544) **Rotameter,** with ivory handle, reading to $\frac{1}{16}$ inch ... **0 8 0**

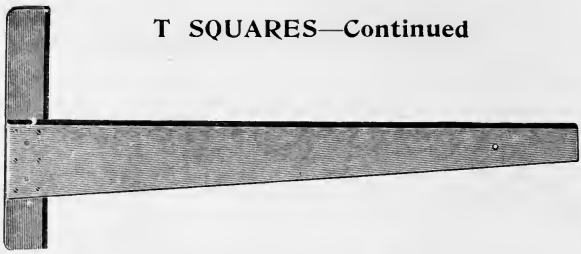
T SQUARES

NOTE.—The prices quoted are, in every case, for T squares of the **best quality,** *made of straight-grained, well-seasoned wood. The blades are well screwed to the stocks, have brass dowels, and are keyed at the extreme end.*

Cheaper qualities *than those listed can be supplied; prices will be sent on application.*

For intricate work *we recommend T squares with* **transparent celluloid edges**; *they are very convenient, perfectly true, and owing to the method of construction their accuracy is not affected by any shrinkage of the celluloid.*

T SQUARES—Continued

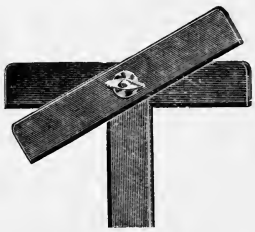


T Squares, with Fixed Heads, Taper Blades—

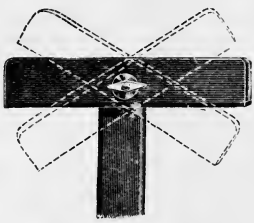
	Inches	24	32	36	42	54
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d
(545)	**Pearwood** (not keyed)	0 1 8	0 2 3	0 2 6	0 2 10	0 3 9
(546)	**Mahogany, ebony edge** ...	0 3 3	0 4 3	0 4 9	0 5 6	0 7 0
(547)	**Mahogany, celluloid edge**	0 4 0	0 5 3	0 6 0	0 6 9	0 9 0

Parallel Blades, with two working edges, 15 % extra (ebony-edged mahogany only).

T Squares, with Shifting Heads (Single or Double), parallel blades, two edges—



Single Shifting Head.



Double Shifting Head.

	Inches	24	32	36	42	54
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
(548)	**Pearwood** ...	0 4 3	0 5 3	0 5 9	0 6 6	0 8 6
(549)	**Mahogany, ebony edge** ...	0 6 3	0 7 9	0 8 6	0 9 9	0 12 6
(550)	**Mahogany, celluloid edge**	0 9 0	0 10 6	0 11 3	0 13 6	0 18 0

(551) THE BROOKS PATENT T SQUARE LOCK

The Brooks Patent T Square Lock is a simple device, which can be attached in a few minutes, by means of the small screws supplied, to any ordinary T square, enabling the latter to be locked in any position on an inclined (or vertical) drawing board, thus setting both hands free to manipulate the set square, etc. The T square may nevertheless be shifted with the same freedom as an ordinary one. Provided with this attachment the draughtsman has all the convenience of an expensive drafting machine together with the accuracy of the T square.

THE BROOKS PATENT T SQUARE LOCK—Continued

No alteration or addition to the drawing board is necessary. The metal parts are all nickel-plated and polished.

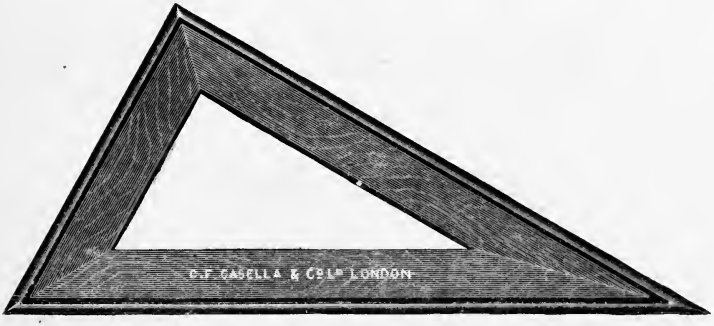
The T Square Lock is made in the following sizes:

Size Number	1	2	3	**4**	**5**	6	7	**8**	9	10	**11**	**12**
To suit: Width of drawing board in inches	16	18	20	**22** Royal	**23** ½ Imp.	28	31	**32** Imperial.	36	41	**42** Double Elephant	**54** Anti-qu'r'n
To suit: Width of T square stock in inches	1½	1½	2	**2**	**2**	2¼	2¾	**2¼**	2¼	2½	**2½**	**2⅝**
To suit: Length of Blade	Assumed to be not more than ⅜ in. shorter than board. If shorter than this, give exact length measured from inside edge of stock											
PRICE	To suit boards not exceeding 24 in. wide, **4/6**; larger sizes up to 54 in., **5/6**. **Intermediate sizes** supplied without extra charge.											

When ordered by name only, the sizes in thick type are sent. If the dimensions of your board and T square differ from the above standard sizes, give exact measurements.

SET SQUARES

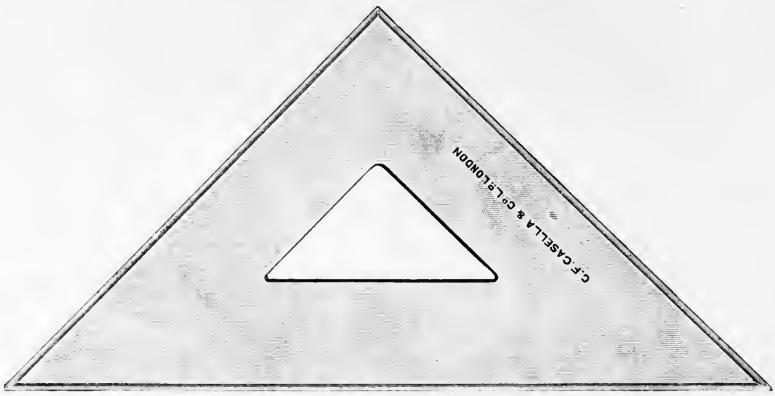
ALL BEST QUALITY



No. 555.

	Inches	5		6		8		10		12	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
(552) **Pearwood**, 45°	... ...	**0**	**3**	**0**	**4**	**0**	**6**	—		—	
(553) **Ditto** 60°	... ...	**0**	**3**	**0**	**4**	**0**	**5**	**0**	**8**	—	
(554) **Mahogany, framed, ebony edge**, 45°	...	**1**	**9**	**2**	**0**	**2**	**6**	**3**	**3**	**4**	**0**
(555) **Ditto, ditto**, 60°	...	**1**	**4**	**1**	**8**	**2**	**0**	**2**	**6**	**3**	**0**

SET SQUARES—Continued



No. 556.

	Inches	5	6	8	10	12
		s. d.	s. d.	s. d.	s. d.	s. d.
(556)	**Celluloid, cut-out centres** 0·06 inch thick, 45°	**0 10**	**1 2**	**1 9**	**2 6**	**4 0**
(557)	**Ditto, ditto,** 60°... ...	**0 8**	**0 10**	**1 4**	**1 9**	**3 0**
(558)	**Ditto,** as No. 556 but 0·08 inch thick, 45° ...	**1 6**	**2 0**	**3 3**	**5 6**	**7 0**
(559)	**Ditto,** 60°	**1 0**	**1 3**	**1 9**	**2 6**	**4 0**

Nos. 558 and 559 can be supplied **single or twin bevelled** *at an extra charge of 25 %. Twin bevelled set squares have the three edges slightly bevelled on both sides for convenience in inking in drawings.*

STRAIGHT EDGES

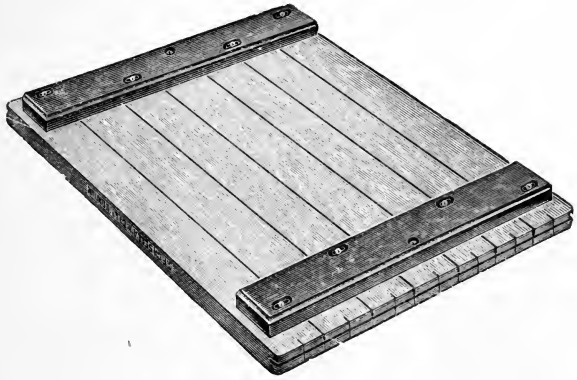
	Inches	30	36	42	54	60	72
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
(560)	**Mahogany,** ebony-edged ...	**2 6**	**3 0**	**3 9**	**5 6**	**6 6**	**8 6**
(561)	**Steel,** bright, one edge bevelled ...	**6 6**	**8 6**	**9 6**	**13 6**	**15 6**	**25 0**
(562)	**Electrum**	**12 6**	**15 0**	**18 0**	**26 0**	**30 0**	**40 0**
(563)	Cases for the above,						
	Deal	**2 0**	**2 6**	**3 0**	**4 0**	**4 6**	**6 6**
	Polished mahogany	**4 6**	**5 6**	**6 6**	**8 6**	**9 6**	**12 0**

Any of the above straight edges divided, with figures, or made in extra lengths, to order.

DRAWING BOARDS

(564) **Pine Drawing Board**, grooved back, mahogany battens, brass slots, one edge inlaid with ebony—

23 × 16 in.	£0	8	4
32 × 23 ,,	0	14	0
41 × 28 ,,	1	1	0
54 × 32 ,,	1	10	0



No. 564.

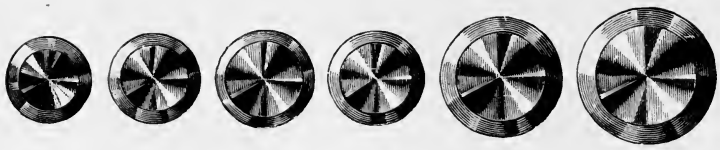
(565) **Deal Clamped Drawing Board**, best quality—

13½ × 9	£0	1	3
15½ × 11	0	1	6
18 × 11½	0	1	10
19 × 13½	0	2	2
22 × 15½	0	2	9
23 × 16	0	3	0
25 × 18	0	3	6
28 × 19	0	4	6
31 × 22	0	5	6
40 × 27	0	12	0
53 × 31	0	18	0

Other sizes made to order. Special rates for quantities of 1 dozen at a time.

(566) **Cavalry Sketching Board**, 7½ × 5 inch, with paper holder, compass, etc.... £1 12 6

DRAWING PINS, ETC.



1 2 2½ 3 5 & 20 5½

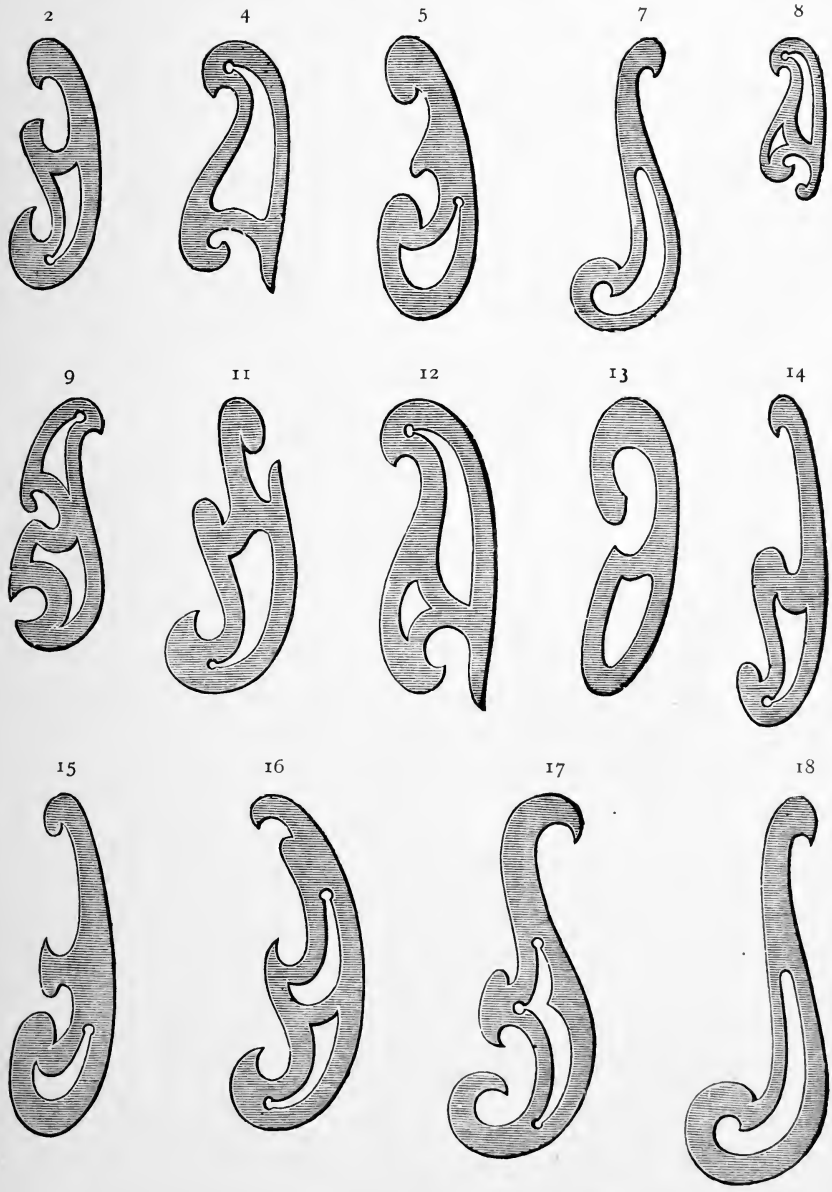
FULL SIZE.

		Per Dozen. s. d.		Per Gross. s. d.
(567)	**Drawing Pins,** best bevelled brass, No. 1	0 3	...	2 4
(568)	**Ditto,** ditto, ditto, No. 2	0 4	...	2 8
(569)	**Ditto,** ditto, ditto, No. 2½	0 4	...	3 4
(570)	**Ditto,** ditto, ditto, milled edge, No. 5 ...	0 5	...	4 0
(571)	**Ditto,** ditto, ditto, extra long pins, milled edge, No. 20	0 8	...	7 4
(572)	**Pin Lifters**... ... ...each			0 2
(573)	**Horn Centres** ... ... ,,			0 3
(574)	**Paper Weights,** lead, covered with buff leather, 3×2×1 inch ... ... each			3 0

CURVES

		Pearwood.	Vulcanite.	Celluloid.
(575)	**Railway Curves,** set of 25, 1½ to 30 inch radius in case ...	£0 16 0	£1 8 6	£1 16 0
(576)	**Ditto,** set of 50	1 5 0	2 15 0	3 5 0
(577)	**Ditto,** set of 100	2 10 0	4 10 0	6 6 0
(578)	**Ditto,** metric, set of 50, 3 cm. to 3 metres radius	1 10 0	3 5 0	3 15 0
		Pearwood.		Celluloid.
(579)	**Ships' Curves,** set of 9	£0 7 6		£0 18 6
(580)	**Ditto,** set of 15	0 10 6		1 10 0
(581)	**Ditto,** set of 40, in mahogany case	1 10 0		4 10 0
(582)	**Elliptical Curves,** set of 20, 1 to 6 inch, in case	0 15 0		—
(583)	**Hyperbolic Curves,** set of 5	0 5 0		0 15 0
(584)	**Parabolic Curves,** set of 12	0 9 6		1 7 6

ARCHITECTS' CURVES



NOTE.—The above illustrations are all drawn to scale, the largest curve (No. 18) is 14 inches long; the smallest (No. 8) is 6 inches.

(585) **Best Pearwood,** Nos. 1, 3, 6, 8 ... ...each **£0 0 4**
(586) Ditto, other numbers ... ... „ **0 0 6**
(587) **Common Curves,** various patterns ... set of one dozen **0 3 0**

DRAWING PAPER

SIZED DRAWING PAPER FOR TROPICAL AND SEMI-TROPICAL CLIMATES

(588) In rolls, 100 yds. × 27 in. ... ... per roll **£1 3 6**

„ „ „ 54 in. ... ... „ **2 5 0**

589) In sheets, 40 in. × 27 in. ... ...per ream **5 10 0**

„ 29½ in. × 22 in. ... ... „ **3 5 0**

GUMMED PAPER ON COTTON

For mounting plans, tracings, etc.

	Per Yard. s.	d.
(590) In rolls, 25 yds. × 30 in....	**1**	**4**
„ „ „ 40 „	**1**	**9**
„ „ „ 54 „	**2**	**3**

SECTIONAL DRAWING PAPER, IN ROLLS

(591) **Continuous Sectional Drawing,** ⅛ in., 1/10 in., or 1/16 in., in rolls, 11 yds. × 26 in.

Unmounted.	On Cotton.	On White Holland.	On Brown Holland.	
£0 8 0	**£1 2 6**	**£1 4 0**	**£1 7 0**	per roll.

(592) **Continuous Sectional Drawing,** thin bistre, millimetre section, in rolls, 11 yds. × 30 in.

Unmounted.	On Cotton.	
£0 7 6	**£1 2 6**	per roll.

SECTIONAL DRAWING PAPER, IN SHEETS

(593) In sheets, 22½ × 17½ in. Per Ream.

1 in., ⅞ in., ¾ in., ⅝ in., ½ in., or ⅜ in.	**£2 10 0**
¼ in., 1/5 in., 1/6 in., or ⅛ in.	**2 15 0**
1/10 in. or 1/12 in.	**3 0 0**
1/16 in. or 1/20 in.	**3 7 6**

SECTIONAL PAPER, IN BOOKS

(594) **Sectional Book,** ⅛ in. or 1/16 in., 6¼ in. × 4 in., in stiff boards, leather backs—

50 Leaves.	100 Leaves.
1s. 3d.	**1s. 9d.**

(595) **Ditto,** in limp roan, with elastic band—

50 Leaves.	100 Leaves.
2s. 0d.	**2s. 3d.**

SECTIONAL PAPER, IN BLOCKS

(596) **Sectional Block,** $\frac{1}{8}$ in. or $\frac{1}{16}$ in., $6\frac{1}{4}$ in. × 4 in.

50 Sheets. **1s. 3d.** 100 Sheets. **2s. 0d.**

(597) **Ditto,** $8\frac{1}{2}$ in. × $5\frac{1}{2}$ in.—

50 Sheets. **1s. 9d.** 100 Sheets. **3s. 0d.**

DRAWING PAPER IN SHEETS, UNMOUNTED

WHATMAN'S HAND-MADE DRAWING PAPER

This paper is made in one quality only, but is sorted at the mill into "perfect" sheets and "retree"; "retree" are slightly, very slightly, defective. The Imperial and larger sizes are supplied with either smooth (hot-pressed) or medium surface.

Medium is always sent *unless smooth is specified.*

Demy and Royal are supplied with smooth surface only.

(All inside sheets.)

		Inches.	Per Ream.	Per Quire
(598)	**Demy**	20 × 15½ ...	£1 15 0	£0 2 6
(599)	**Royal**	24 × 19 ...	3 10 0	0 4 9
(600)	**Imperial,** perfect	30 × 22 ...	5 15 0	0 7 6
	retree	30 × 22 ...	5 2 0	0 6 9
	extra thick, perfect ...	30 × 22 ...	—	0 12 6
(601)	**Double Elephant,** perfect	40 × 27 ...	11 0 0	0 14 0
	retree	40 × 27 ...	9 15 0	0 13 0
	extra thick, perfect ...	40 × 27 ...	—	1 2 0

CARTRIDGE PAPER

(602)	**Imperial**...	30 × 22 ...	£2 0 0	£0 2 6
(603)	**Double Elephant**	30 × 22 ...	3 12 6	0 4 0

DRAWING PAPER IN SHEETS, MOUNTED

WHATMAN'S HAND-MADE

		Inches.	Mounted on	Per Quire.	Per Sheet.
(604)	**Imperial,** perfect ...	30 × 22	cotton	£1 1 0	£0 1 2
(605)	**Ditto,** ditto	30 × 22	brown holland	1 7 6	0 1 6
(606)	**Double Elephant,** perfect	40 × 27	cotton	1 15 0	0 1 8
(607)	**Ditto,** ditto	40 × 27	brown holland	2 8 0	0 2 6

DRAWING PAPER IN ROLLS, UNMOUNTED

(608) **Joynson's Continuous Drawing Paper—**

(*Three surfaces: rolled, machine finished or rough.*)

	Per Yard. Stout.	Thin.
	s. d.	s. d.
In rolls, 50 yds. × 27 in.	0 6 ...	0 5
,, ,, ,, 30 ,, ...	0 7 ...	0 6
,, ,, ,, 54 ,, ...	0 10 ...	0 9

(609) **Continuous Drawing Paper, extra quality—**

	Per Yard. Stout.	Middle.	Thin.
	s. d.	s. d.	s. d.
In rolls, 50 yds. × 27 in. ...	0 6 ...	0 5 ...	0 4
,, ,, ,, 30 ,, ...	0 7 ...	0 6 ...	0 5
,, ,, ,, 40 ,, ...	0 9 ...	0 7 ...	—
,, ,, ,, 54 ,, ...	1 0 ...	0 10 ...	0 7

(610) **Continuous Drawing Cartridge—**

	Stout.	Thin.
	s. d.	s. d.
In rolls, 50 yds. × 27 in., per yard ...	0 4 ...	0 3
,, ,, ,, 30 ,, ,, ...	0 5 ...	0 4
,, ,, ,, 54 ,, ,, ...	0 8 ...	0 7

DRAWING PAPER IN ROLLS, MOUNTED

WHATMAN'S HAND-MADE.

	MOUNTED ON Brown Holland.	White Holland.	Thin Cartridge and Brown Holland.
	s. d.	s. d.	s. d.
(611) In rolls, 25 yds. × 22 in., per yard	1 6 ...	1 4 ...	1 10
,, ,, ,, 26 ,, ,,	1 9 ...	1 6 ...	2 3
,, ,, ,, 30 ,, ,,	2 0 ...	1 9 ...	2 6
,, ,, ,, 39 ,, ,,	2 6 ...	2 3 ...	3 6
,, ,, ,, 52 ,, ,,	3 3 ...	3 0 ...	4 6

(612) **Continuous Drawing, extra quality, mounted on cotton—**

	Per Yard.
	s. d.
In rolls, 25 yds. × 27 in.	1 3
,, ,, ,, 30 ,, ...	1 4
,, ,, ,, 40 ,, ...	1 9
,, ,, ,, 54 ,, ...	2 4

(613) **Continuous Drawing, Stout, mounted on brown holland—**

	Per Yard.
	s. d.
In rolls, 25 yds. × 27 in.	1 5
,, ,, ,, 30 ,, ...	1 6
,, ,, ,, 54 ,, ...	2 8

DRAWING PAPER IN BLOCKS

(614) **Solid Sketch Block,** Whatman's paper—

Inches	5×3½	7×5	10×7
	s. d.	s. d.	s. d.
Block only	1 0	1 9	2 6
Block and Canvas Case ...	1 9	2 6	3 9

(615) **Ditto,** fine cartridge paper—

Inches	5×3½	7×5	10×7
	s. d.	s. d.	s. d.
Block only	0 6	0 9	1 3

LEVEL AND FIELD BOOKS, Etc.

(616) **Level Book,** bound full leather, numbered pages, 6½ in. × 4 in. ruled as below—

B.S.	Int.	F.S.	H.P.C.	Red. Level.	Distance.	Remarks.

Price, **1s. 9d.** each.

(617) **Ditto,** bound full leather, 7½ in. × 4½ in., ruled as below—

Back.	Interm.	Fore.	Rise.	Fall.	Reduced Level.	Distance.	Remarks.

Price, **2s. 0d.** each.

(618) **Ditto,** bound full leather, 7½ in. × 4½ in., ruled as below—

Back.	Interm.	Fore.	Rise.	Fall.	Height above Base.	Distance.	Remarks.

Price, **2s. 0d.** each.

(619) **Field Book,** plain, or faint ruling, two red lines down centre, stiff cover, leather back ... ... **1s. 6d.**

(620) **Ditto,** as No. 619, but 7 in. × 4¼ in. ... ... **1s. 6d.**

(621) **Ditto,** as above, but with two red lines down centre ... **1s. 0d.**

(622) **Ditto,** as No. 621, but 7 in. × 4¼ in. ... ... **1s. 6d.**

(623) **Quantity Book,** four blue lines, stiff cover, leather back **1s. 6d.**

TRACING CLOTH AND PAPER

TRACING CLOTH

(624) "**Alliance**" **Tracing Cloth**, thick, blue, in rolls of 24 yards—

30 in.	37 in.	40 in.	42 in.	wide.
£1 0 0	£1 4 0	£1 6 0	£1 10 0	per roll.

(625) **Sagar's Tracing Cloth**, thin, blue, in rolls of 24 yards—

18 in.	30 in.	38 in.	40 in.	wide.
£0 14 0	£1 4 0	£1 6 0	£1 12 0	per roll.

(626) "**Imperial**" **Tracing Cloth**, thin, blue, in rolls of 24 yards—

18 in.	30 in.	38 in.	41 in.	wide.
£0 14 0	£1 4 0	£1 12 0	£1 14 6	per roll.

(627) "**Reliance**" **Tracing Cloth**, thick, blue, in rolls of 24 yards—

18 in.	30 in.	37 in.	40 in.	wide.
£0 10 6	£0 17 0	£0 19 0	£1 2 0	per roll.

TRACING PAPER

(628) **Tracing Paper**, stout substance, blue or white—

In rolls, 20 yds. × 40 in....	per roll	£0 7 6
	Per Ream.	Per Quire.
In sheets, 30 in. × 20 in....	£4 0 0 ...	£0 5 0
,, 40 in. × 30 in....	7 7 0 ...	0 8 0

(629) **Ditto**, medium substance, blue or white—

In rolls, 20 yds. × 40 in....	per roll	£0 6 9
	Per Ream.	Per Quire.
In sheets, 30 in. × 20 in....	£3 7 6 ...	£0 4 0
,, 40 in. × 30 in....	6 0 0 ...	0 7 0

(630) **Ditto**, extra thin substance, blue—

In rolls, 20 yds. × 40 in....	per roll	£0 5 6
	Per Ream.	Per Quire.
In sheets, 30 in. × 20 in....	£2 15 0 ...	£0 3 3
,, 40 in. × 30 in....	5 7 6 ...	0 6 0

(631) **Detail Tracing Paper**, medium substance, white—

In rolls, 50 yds. × 62 in....	per roll	£0 14 6
,, 50 yds. × 31 in....	,,	0 7 6

(632) **Ditto**, thin substance, white—

In rolls, 50 yds. × 62 in....	per roll	£0 12 0
,, 50 yds. × 31 in....	,,	0 6 3

PHOTOGRAPHIC PAPERS AND LINENS

(633) **Ferroprussiate Paper,** slow or rapid, **ordinary quality,** thin or medium substance— Per Roll.

In rolls, 11 yds. × 30 in. £0 2 0
,, ,, × 40 ,, ... 0 2 9

(634) Ditto, **best quality,** thin or medium—

In rolls, 11 yds. × 30 in. £0 3 6
,, ,, × 40 ,, ... 0 4 9

(635) **Ferro prussiate Linen**—

In rolls, 11 yds. × 30 in. £0 10 6
,, ,, × 40 ,, ... 0 14 0

(636) **Ferrogallic Paper** (black line), **ordinary quality,** thick—

In rolls, 11 yds. × 30 in. £0 6 6
,, ,, × 40 ,, ... 0 8 6

(637) Ditto, extra thick—

In rolls, 11 yds. × 30 in. £0 8 0
,, ,, × 40 ,, ... 0 10 0

(638) **Ferrogallic Paper,** best quality, suitable for colouring, thick—

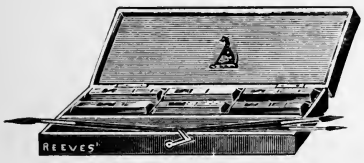
In rolls, 11 yds. × 30 in. £0 8 0
,, ,, × 40 ,, ... 0 10 0

(639) Ditto, extra thick—

In rolls, 11 yds. × 30 in. £0 9 0
,, ,, × 40 ,, ... 0 11 0

WATER COLOUR BOXES

The following colours, brushes, etc., are made by Messrs. Reeves & Sons, Ltd., and are listed at their prices.



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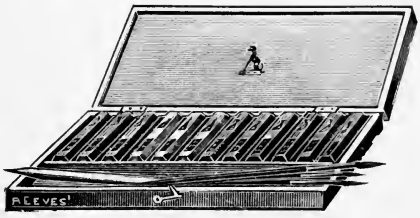


No. 641.

(640) **Polished Mahogany Box,** containing **hexagon double cakes** of

Crimson lake Yellow ochre Vandyke brown and
Prussian blue Burnt sienna Green bice

And 3 Siberian hair brushes.

Price £0 11 0

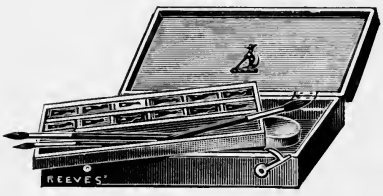
WATER COLOUR BOXES—Continued

(641) **Polished Mahogany Box,** containing **hexagon double cakes** of

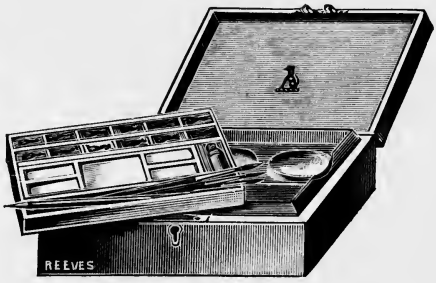
Crimson lake	Vandyke brown	Pale chrome
Prussian blue	Green bice	French ultra
Yellow ochre	Light red	Burnt umber
Burnt sienna	Gamboge	Neutral tint

with pencil, and 3 Siberian hair brushes.

Price **£0 18 3**



No. 642.



No. 643.

(642) **Polished Mahogany Box,** caddy lid, containing **half cakes** of

Crimson lake	Gamboge	Vandyke brown
Light red	Pale chrome	Green bice
Burnt sienna	Prussian blue	Burnt umber and
Yellow ochre	French ultra	Neutral tint

and 3 Siberian hair brushes, with tray, under which are 3 china saucers.

Price **£0 11 0**

(643) **Ditto,** as No. 642, but with lock to box, and with the following additions—

Chinese white	Divided china tile
Pencil	6 saucers (instead of 3)

Price **£0 16 6**

(644) **Empty Water Colour Boxes,** japanned, for pans and half pans—

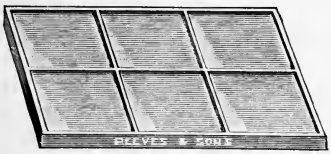
To hold 6 whole pans **£0 3 0**

,, 12 ,, ,, ... **0 4 6**

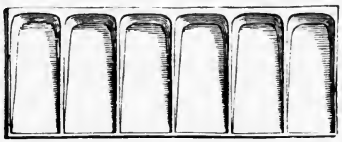
,, 6 half pans **0 3 0**

,, 12 ,, ,, ... **0 4 0**

CHINA SAUCERS, PALETTES, ETC.



No. 647.



No. 646.

(645) **Set of 6 Saucers**—

$2\frac{5}{8}$ **1s. 4d.** $3\frac{1}{4}$ **1s. 7d.** $3\frac{3}{4}$ **2s. 0d.** inches diameter.

(646) **Slope Tiles**—

	s.	d.
$3\frac{3}{4} \times 1\frac{1}{2}$ in., 2 divisions ... ...each	**0**	**3**
4 × 3 ,, 3 ,, ... ,,	**0**	**4**
$7\frac{5}{8} \times 2\frac{7}{8}$,, 4 ,, ... ,,	**0**	**7**

(647) **Flat Tiles**—

$6\frac{3}{4} \times 2\frac{1}{4}$ in., 3 divisions ... ...each	**0**	**6**
$7\frac{1}{4} \times 4\frac{3}{4}$,, 6 ,, ... ,,	**1**	**0**

WATER COLOURS

DRY CAKES

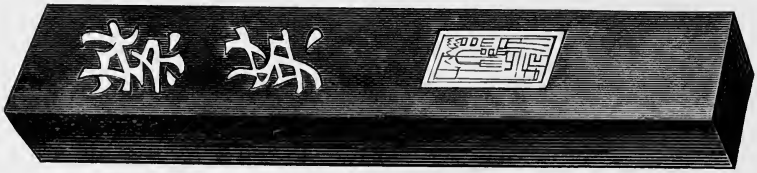
	Half Cake. s. d.	Whole Cake. s. d.	Double Cake. s. d.
(648) Burnt sienna	**0 5**	**0 8**	—
(649) Burnt umber	**0 5**	**0 8**	—
(650) Carmine	**0 10**	**1 4**	**2 4**
(651) Chinese white	**0 5**	**0 8**	**1 2**
(652) Crimson lake	**0 8**	**1 0**	**1 8**
(653) French ultramarine... ...	**0 5**	**0 8**	**1 2**
(654) Gamboge	**0 5**	**0 8**	**1 2**
(655) Green bice	**0 5**	**0 8**	**1 2**
(656) Light red	**0 5**	**0 8**	**1 2**
(657) Neutral tint	**0 5**	**0 8**	**1 2**
(658) Pale chrome	**0 5**	**0 8**	**1 2**
(659) Prussian blue	**0 5**	**0 8**	**1 2**
(660) Vandyke brown	**0 5**	**0 8**	**1 2**
(661) Vermilion	**0 5**	**0 8**	**1 2**
(662) Warm sepia	**0 8**	**1 0**	—
(663) Yellow ochre	**0 5**	**0 8**	**1 2**

WATER COLOURS—Continued

	MOIST	Half Pans. s.	d.	Whole Pans. s.	d.
(664)	Burnt sienna	0	5	0	8
(665)	Burnt umber	0	5	0	8
(666)	Carmine	0	10	1	4
(667)	Chinese white	0	5	0	8
(668)	Crimson lake	0	8	1	0
(669)	French ultramarine	0	5	0	8
(670)	Gamboge	0	5	0	8
(671)	Green bice	0	5	0	8
(672)	Light red	0	5	0	8
(673)	Neutral tint	0	5	0	8
(674)	Pale chrome	0	5	0	8
(675)	Prussian blue	0	5	0	8
(676)	Vandyke brown	0	5	0	8
(677)	Vermilion	0	5	0	8
(678)	Warm sepia	0	8	1	0
(679)	Yellow ochre	0	5	0	8

INDIAN INK

IN STICKS



No. 680.

		Per Stick s.	d.
(680)	Square Sticks, 12 to the pound, super super	1	6
(681)	Hexagon „ 8 „ „	2	4

LIQUID

FIXED INDIAN INK

		s.	d.
(682)	In large bottles ...each	0	10
(683)	In small bottles .,	0	6
(684)	In ¼-pint bottles „	3	0
(685)	In ½-pint bottles „	5	6

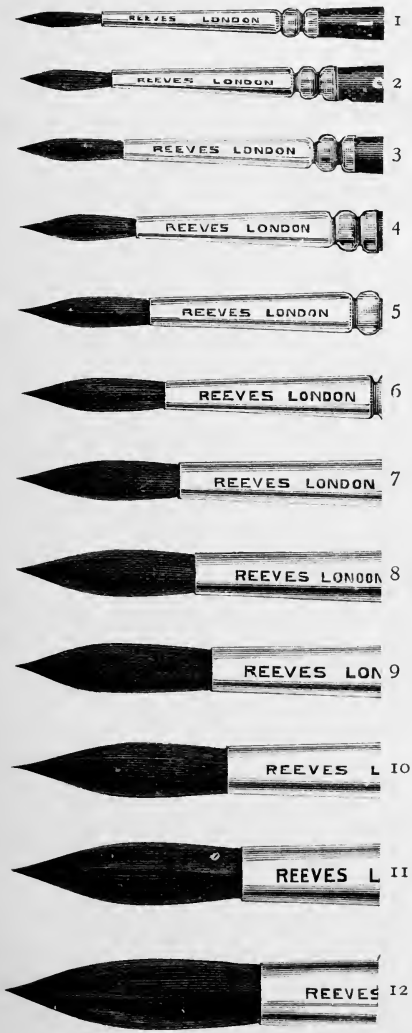
WATERPROOF LIQUID INKS

All thoroughly fixed.

Burnt sienna	Neutral tint	Ultramarine
Carmine	Prussian blue	Vermilion
Cobalt blue	Scarlet	Yellow
Emerald green	Sepia	and other colours

		s.	d.
(686)	In large bottles ... ...each	0	10
(687)	In small bottles ... ... „	0	6
(688)	In ¼-pint bottles ... ... „	3	0
(689)	In ½-pint bottles ... ... „	5	6

(690) WATER COLOUR BRUSHES



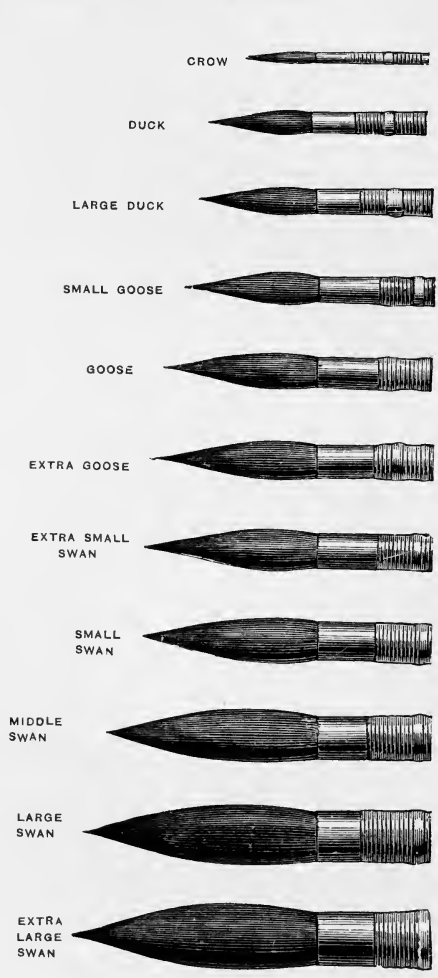
In nickelled ferrules on polished black handles.

No.		Siberian Hair. Each. s.	d.		Camel Hair. Each. s.	d.
1	...	0	3	...	0	2
2	...	0	3	...	0	2
3	...	0	3	...	0	2
4	...	0	3	...	0	3
5	...	0	4	...	0	3
6	...	0	5	...	0	3
7	...	0	7	...	0	4
8	...	0	9	...	0	4
9	...	0	11	...	0	5
10	...	1	2	...	0	6
11	...	1	5	...	0	7
12	...	1	9	...	0	8

(The illustrations are full size.)

WATER COLOUR BRUSHES—Continued

(691) **In quills, red or brown sable—**



	Each. s.	d.
CROW	0	3
DUCK	0	6
LARGE DUCK	0	7
SMALL GOOSE	0	10
GOOSE	1	0
EXTRA GOOSE	1	6
EXTRA SMALL SWAN	3	0
SMALL SWAN	3	6
MIDDLE SWAN	4	6
LARGE SWAN	6	0
EXTRA LARGE SWAN	7	0

(692) **Pocket Brush,** in quill, set in reversible vulcanite holder, red sable hair... ... ... **£0 5 0**

(693) **Ditto,** Siberian hair **0 2 6**

(694) **Pocket Brush**, in metal ferrule, set in reversible vulcanite holder (No. 6, p. 125) **0 2 6**

(695) **Ditto,** Siberian hair (No. 6, p. 125) **0 1 2**

(696) **Ditto,** ditto (No. 5, p. 125) **0 1 3**

STENCIL PLATES

	⅛ in.		¼-in.		⅜-in.		½-in.		⅝-in.		¾-in.		1-in.	
(697) **Plain Block Letters:**	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
Alphabet, A to Z ...	4	0	4	6	5	0	5	6	6	0	6	6	7	6
Words, per doz. letters	1	6	1	6	2	0	2	0	2	6	3	0	3	6
Figures, No. 0 to 9 ...	2	0	2	0	2	0	2	0	2	6	3	0	3	6
(698) **Plain Roman Letters:**														
Alphabet, A to Z ...	4	4	4	6	5	0	5	6	6	0	6	6	7	6
Words, per doz. letters	1	6	1	6	2	0	2	0	2	6	3	0	3	6
Figures, No. 0 to 9 ...	2	0	2	0	2	0	2	0	2	6	3	0	3	6
(699) **Shaded Roman Letters:**														
Alphabet, A to Z ...	—		6	0	6	6	7	0	8	0	9	6	12	0
Words, per doz. letters	—		4	0	4	0	4	6	5	0	5	6	6	0
Figures, No. 0 to 9 ...	—		4	0	4	0	4	6	5	0	5	6	6	0
(700) **Ornamental Letters:**														
Alphabet, A to Z ...	—		6	6	7	6	9	0	10	6	12	0	15	0
Words, per doz. letters	—		4	0	4	6	5	0	6	0	7	0	8	0
Figures, No. 0 to 9 ...	—		4	0	4	6	5	0	6	0	7	0	8	0

WALKER'S SHIP LOGS, ETC.

Although we are not makers of ship logs, we are frequently asked to supply them, and we think it may be a convenience to our customers to have them included in this catalogue.

(701) "**Neptune**" Ship Log, complete with 1 register, 2 rotators, 2 shoes, 1 hook, 1 brass wheel governor, 3 glasses and 1 No. 6 "Neptune" log line, 65 fathoms **£7 7 0**

(702) "**Trident**" Ship Log, complete with 1 register, 2 rotators, 2 shoes, 1 hook, 1 brass wheel governor, 3 glasses and 1 No. 6 "Neptune" log line, 65 fathoms **7 7 0**

WALKER'S SHIP LOGS, ETC.—Continued

(703)	"**Neptune**" or "**Trident**" **Electric** Ship Log, complete with register, with electrical attachment and connexion box, 2 rotators, 2 shoes, 1 hook, 1 brass wheel governor, 3 glasses and 1 No. 6 "Neptune" log line, 65 fathoms	£11	15	0	
	Chart-room Register	4	18	6	
	4 Batteries, large, best quality, in box complete	2	18	6	
					19 12 0
(704)	"**Neptune**" Rotator				0 14 0
	"**Cherub II.**" Ship Log, complete with register, 2 rotators, 2 shoes, 1 hook and 3 glasses				4 7 0
(705)	**Rotator** for "Cherub II.," "Cherub" and "Trident" Ship Logs				0 14 0
(706)	**Ship Log Connector**				2 13 6
(707)	"**Rocket**" Ship Log, complete with register, rotator, hook and a 35-fathom log line				3 4 0
(708)	"**Rocket**" Rotator				0 11 6
(709)	**Fly-wheel Governor** for "Neptune," "Trident," "Cherub II.," "Cherub" and "Rocket" Ship Logs... ... ... Brass				0 9 6
	Iron				0 5 6
(710)	"**Ixion**" **Regulator**				0 5 6
(711)	**A1** "**Harpoon**" Ship Log				2 7 0
(712)	**A2** "**Harpoon**" Ship Log				2 2 0
(713)	**A1** "**Harpoon**" Yacht Log				2 7 0
(714)	**Massey's** Yacht Log				2 7 0
(715)	**No. 1 "Anchor"** Ship Log				2 2 0
(716)	**No. 2 "Anchor"** Ship Log				1 17 6
(717)	"**Excelsior**" Yacht Log, complete with register (with outrigger and governor), 1 rotator, 1 hook, 1 shoe, 100 feet of line, and sinker				2 13 6
(718)	"**Excelsior**" Yacht Rotator				0 7 6
(719)	"**Harpoon**" **Sounding Machine**, without lead—				
	To register 150 fathoms				2 2 0
	To register 300 fathoms				2 7 0

For **Current Meters**, see our **Meteorological Catalogue.**

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